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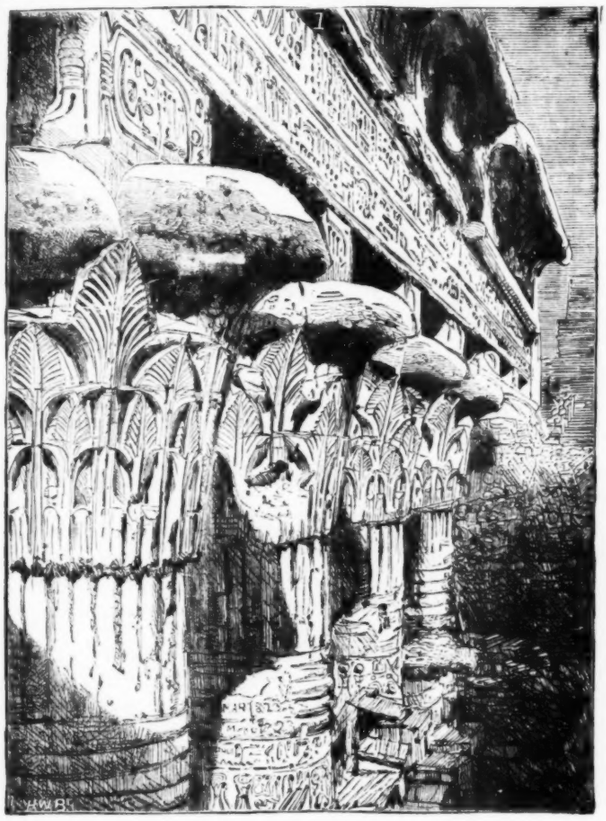
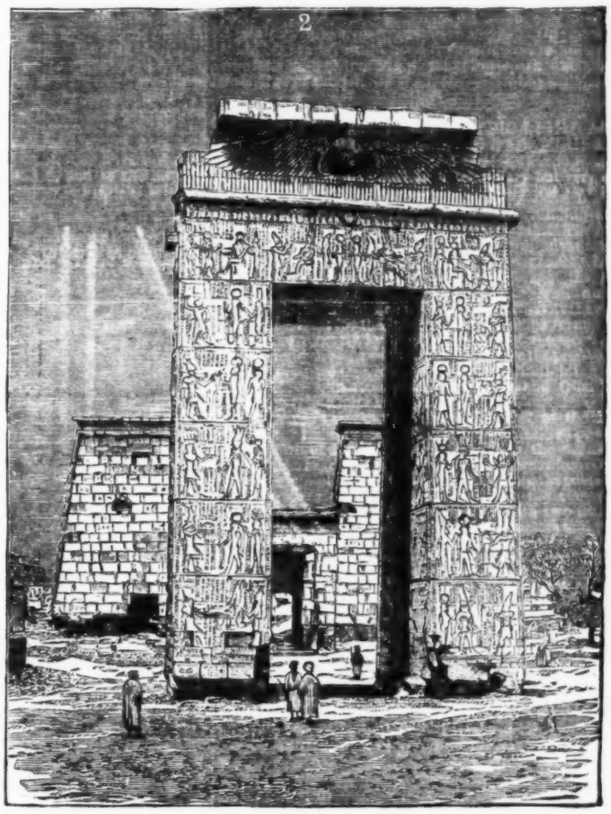
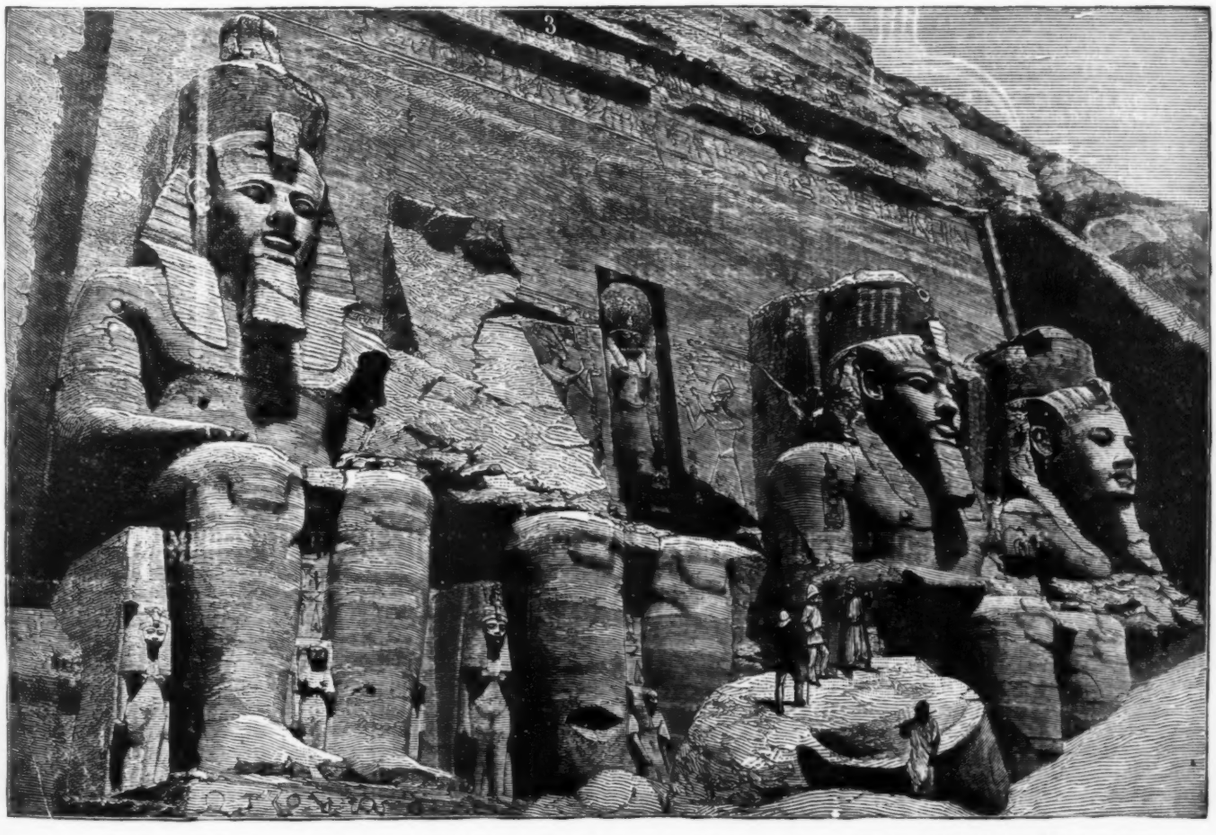
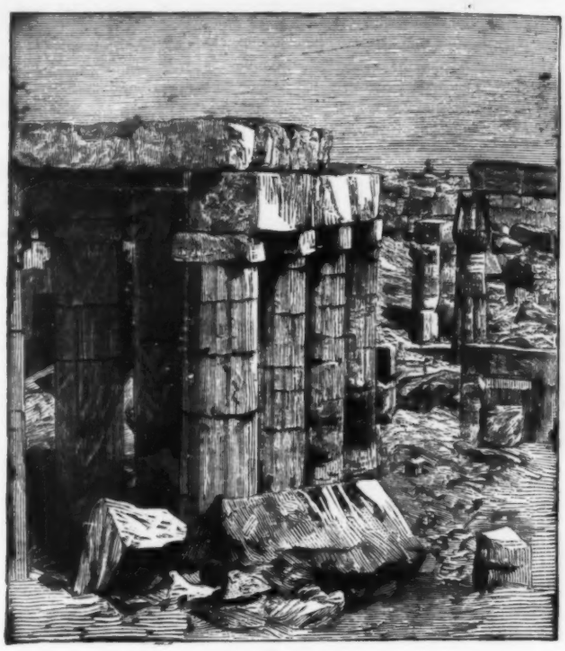






1.—TEMPLE AT ESNEH. 2.—PYLON OF PTOLEMY EUERGETES. 3.—FRONT OF THE GREAT TEMPLE AT ABOO SIMBEL.

DENDERAH.



KARNAK.

EGYPTIAN ANTIQUITIES.

A CORRESPONDENT of the London *Graphic* has lately made a tour of the River Nile, visiting most of the remarkable historical places, and sending home a series of spirited sketches from ancient Thebes and vicinity, some of which we here reproduce. Several additional engravings will be found in SCIENTIFIC AMERICAN SUPPLEMENT, No. 267.

The monuments of Thebes, exclusive of its sepulchral grottoes, occupy a space on both sides of the River Nile, of which the extreme length from north to south is about two miles, and the extreme breadth from east to west about four. The city was on the eastern bank, where is the great temple, or rather the collection of temples, called after El-Karnak, a modern village near by. The temple of El-Karnak is about half a mile from the river, in the cultivable land. More than a mile to the southwest is the temple of El-Uksur, on the bank of the Nile. On the western bank was the suburb bearing the name Memnonia.

The desert near the northernmost of the temples on this side, the Setheum, almost reaches the river, but soon recedes, leaving a fertile plain generally more than a mile in breadth. Along the edge of the desert, besides the Setheum, are the Rameseum of El-Kurneh, and, less than a mile farther to the southwest, that of Medeenet-Haboo, and between them, but within the cultivated land, the remains of the Amenophraim, with its two gigantic seated colossi. Behind these edifices rises the mountain, which here attains a height of about 1,200 feet. It gradually recedes in a southwesterly direction, and is separated from the cultivated tract by a strip of desert, in which are numerous tombs, partly excavated in two isolated hills, and two small temples. A tortuous valley, which begins not far from the Setheum, leads to those valleys in which are excavated the tombs of the kings beneath the highest part of the mountain which towers above them in bold and picturesque forms. The temple of El-Uksur is nearest of the edifices to the river, and but an appendage to the great group of El-Karnak. It takes its name from the small town of El-Uksur, or Abu l-Haggag, which is built in and around part of it, thus injuring its effect, and rendering examination difficult. It differs from most Egyptian temples in not facing the river, but this is accounted for by its connection with the temple of El-Karnak, from the southern approaches to which a long avenue of sphinxes (now wholly ruined) leads to it, ending at its entrance. This is a massive propylon, or portal with wings, 200 feet in width, before which is a very fine obelisk of red granite. Its fellow, which stood on the western side, was removed by the French to Paris in 1881, and now adorns the Place de la Concorde. Both have beautifully cut hieroglyphic inscriptions.

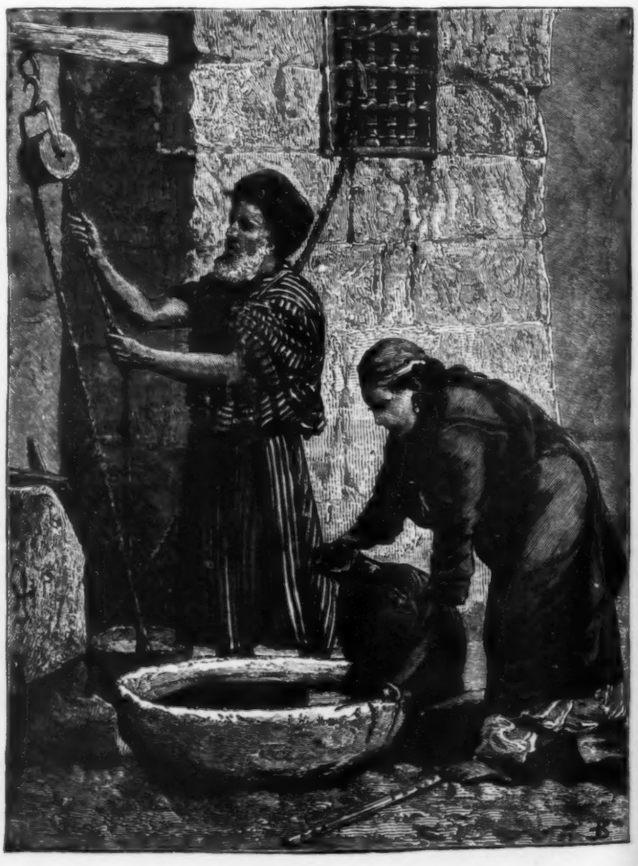
The height of that which remains is about 80 feet. It is adorned with three vertical lines of hieroglyphics on each side, bearing the titles of Ramses II.

The other obelisk differs from this only in being slightly shorter. Close to the winged portal are three seated statues of red granite representing Ramses II.; a fourth has been destroyed. The wings of the portal are covered with sculptures of remarkable interest, representing occurrences in the war of Ramses II. with the Kheta or Hittites, in his fifth year.

On the left wing is depicted the defeat by the Egyptians, led by their king, of the confederate peoples, under the walls of the Hittite stronghold, called Ketesh, or Kadesh, on the Orontes. The king is represented, according to the Egyptian custom, of a gigantic size, standing in his chariot, which he has urged into the midst of the hostile force, whose warriors fall by his well directed arrows. The Egyptians, on the other hand, sustain no loss.

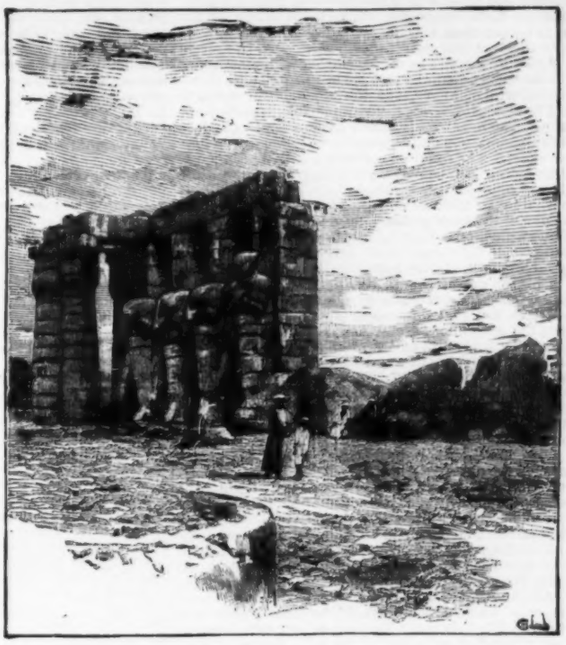
On the right wing is represented the Egyptian camp. This has been sculptured over another subject, of which part may now be seen, owing to the falling out of the plas-

WHIRLING DERVISHES.



FOUNTAIN OR WELL.

COLOSSI AT THEBES.



RAMESEUM, WITH FALLEN FIGURE OF RAMESES II.

ter with which it has been filled. All these representations are in sunk relief, and beautifully executed.

The entrance to the temple is contracted by a modern wall, through the small door of which we pass into a great court choked by the huts of the town, among which stands a mosque. The court is surrounded by a double row of columns, the capitals of which have the form of the bud of the papyrus. A ruined portal with wings forms the end of this court, and with it begins the older part of the edifice, which has a more southerly direction; and its southernmost part, in like manner, turns a little more in that direction, that is, from the river, though not so remarkably. Some deviation was probably rendered necessary by the course of the Nile. The second court is much obstructed by rubbish; nothing is seen of it but a magnificent central avenue of fourteen columns, having capitals of the bell-shaped flower of the papyrus. The columns are about 60 feet in height, of fine form, and elegantly sculptured.

They were raised by Amenophis III., whose name is the oldest which occurs on them and in the rest of the temple.

Behind this is another court, which has a double row of columns on each side, and at its end a portico supported by columns four deep.

This court is much ruined. Beyond it are several chambers of the time of Amenophis III., and in the midst of them an isolated sanctuary, the sculptures of which bear the name of Alexander Ægus, in whose reign it was built, in the place, no doubt, of one destroyed by the Persians under Cambyses or Ochus, as Sir Gardner Wilkinson remarks (Modern Egypt and Thebes, ii., 245). Most of these apartments are in a dilapidated state.

EL-KARNAK.

Although there is an approach to the temple of El-Karnak from that of El-Uksur, the grand entrance was toward the river, and from that direction it should be entered. This extraordinary assemblage of buildings consisted of a great temple, and several smaller structures, surrounded by a massive, crude brick wall. There are other remains similarly inclosed, which were connected with the great temple.

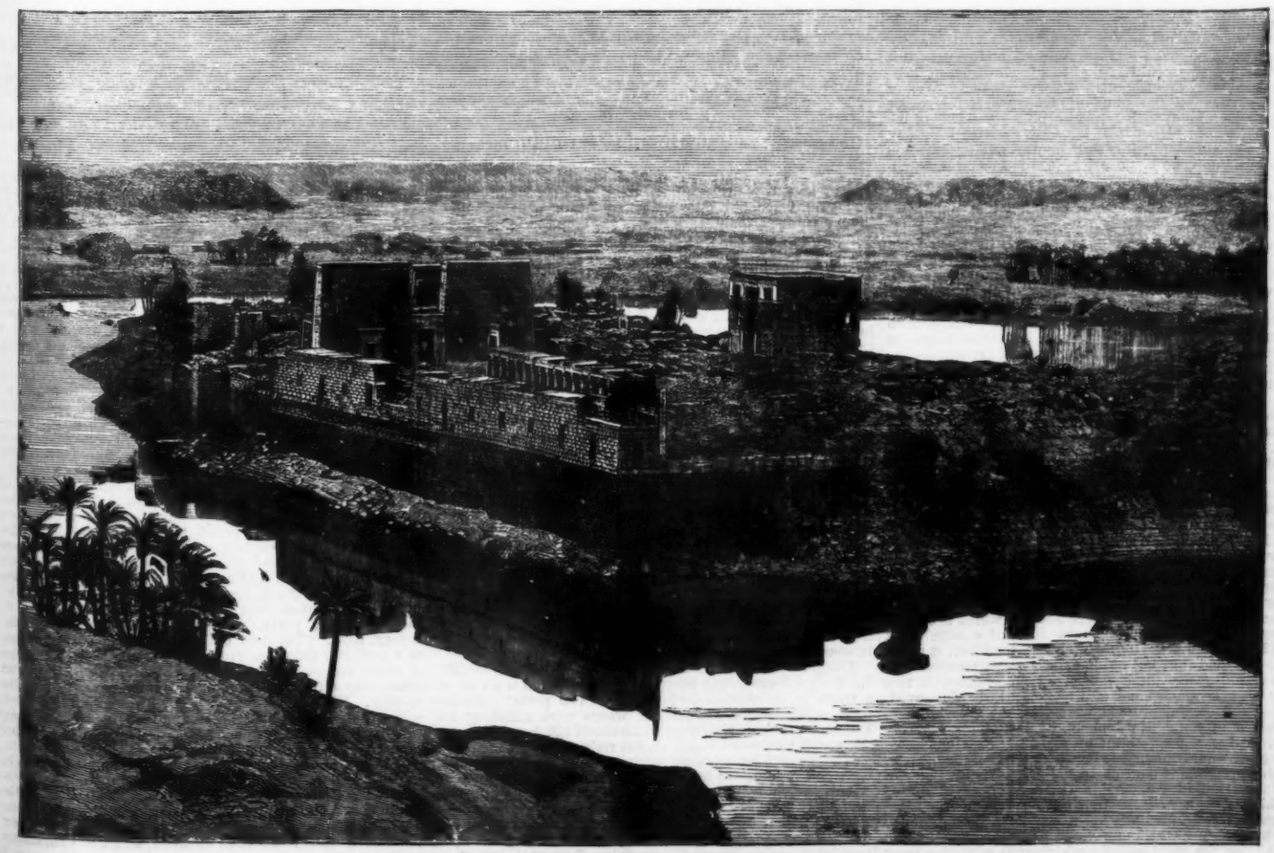
The grand entrance is through a propylon more than 360 feet wide, for this is its measure above the rubbish which is piled up around it. It was never sculptured, nor was its surface smoothed.

It presents, therefore, a rude appearance, and is much ruined, a great part of the left or northern wing having been demolished. The court of which the propylon forms the front measures 329 feet in width and 275 feet in length, having on each side a gallery with a single row of columns; and a double colonnade, of which one column alone stands, formed an avenue from its entrance to that of the hypostyle hall beyond. On the right side a temple of older date interrupts the side gallery, extending 50 feet into the court. Its front is formed by a propylon, about 90 feet wide, on each wing of which Ramses III. is portrayed in the act of slaying prisoners before Amen-ra. The interior of this temple consists of a court, which has on each side a row of Osiridean pillars, and at the end another row of such pillars with columns; behind them, a hall or portico supported by eight columns; next to the court, and beyond, other apartments. Nearly all the sculptures are of the reign of Ramses III., but the names of later sovereigns occur.

On the other side of the great court is a small structure which may be called a chapel, or three chapels. The most interesting sculptures in this part of the group of temples are outside the eastern portion of the south wall of the great court, for here is the famous list of countries and towns subdued by Sheshonk I., or Shishak, the head of Dynasty XXII.

Among the names is that thought to be the kingdom of Judah, and those of several places in the dominions of Rehoboam and Jeroboam I.

At the end of the court is a fine portal, the wings of which are much ruined. This is the entrance to the great hypostyle hall, the most magnificent work of its class in Egypt. Its length is 170 feet, and its width 329; it is supported by 134 columns, the loftiest of which are nearly 70 feet in height, and about 12 in diameter, and the rest more than 40



GENERAL VIEW OF PHILÆ FROM THE ISLAND OF BIGGEH.

feet in height and about 9 in diameter. The great columns, 12 in number, form an avenue through the midst of the court from the entrance, and the others are arranged in rows very near together on each side. There is a transverse avenue made by two rows of the smaller columns being placed farther apart than the rest. This great hall is therefore crowded with columns, and the effect is surprisingly grand. The spectator, being generally unable to see beyond the columns which are immediately around him, perceives the vast dimensions which, if viewed from a distance, might lose their effect. The forest of columns seems interminable in whatever direction he looks, producing a result unsurpassed in any other Egyptian temple.

The partial ruin of its stone roof and of some of the columns renders the hall the more picturesque, and makes us wonder at the force which must have been expended in attempting to demolish it. This grand hall was built by Setee I., Dynasty XIX., and sculptured partly in his reign and partly in that of his son and successor, Ramses II., who has sometimes effaced his father's name to substitute his own. It commemorates, not in its grandeur alone, but also by its sculptures, the magnificence and power of these two great Pharaohs. The sculptures of the interior of the walls represent these kings making offerings to the gods, and the like subjects occupy the columns. Far more interesting are those which adorn the exterior of the walls, and record the achievements of the same kings, those of Setee I. being on the north wall, and those of Ramses II. on the south. The former are of much greater interest than the latter, as far as we can judge, and in this respect inferior to none in Egypt. The scenes on the north wall are arranged in three compartments, of which the upper one has been nearly destroyed. On these scenes the king is represented of a gigantic size, charging in his chariot, and putting to the rout his enemies, capturing their strongholds, and returning home in triumph. The chief nations are the Kheta, or Hittites; the Ruten (Suten), at this time a great nation of Syria; the Shaso, or Arabs; the Kholu, Syria, or Syrians; and Remenen, Armenia. Among the captured places is Ketesh, in those days the most important stronghold between Egypt and Mesopotamia. There is also a long list of countries, cities, and tribes, conquered or ruled by the king, among which we find Naharina, that is, Aram-naha-raim, or Mesopotamia. Kesh, Kush, or Ethopia, etc.

The battle scenes of Ramses II. on the south wall do not, as far as they are seen, equal these in interest. Here also is a list of the king's conquests and possessions, and on the west side of a wall which joins this one at right angles, forming the side of a court of the southern approach to the temple, is a representation of the capture of Askelena or Ascalon, and an inscription recording the treaty between Ramses II. and the Kheta, concluded in the twenty-first year of his reign.

The back of the hypostyle hall is formed by a ruined propylon, bearing the name of Amenophis III., and then at a distance of about 50 feet is another propylon, entirely ruined. In the space between these propyla, which was a court, stands a beautiful obelisk of red granite, upwards of 70 feet high, raised by Thothmes I. The fragments of its fellow, which was more to the north, strew the ground. Behind the second of these propyla is another granite obelisk, 108 feet high, and according to M. Mariette, the loftiest known. (Monuments of Upper Egypt, 170.)

This great obelisk of El-Karnak is a monument of Queen Hatshepu of Dynasty XVIII., and an inscription on its pedestal records the period which elapsed (nineteen months) from the time that it was begun to be cut in the quarry until its completion in the Queen's sixteenth year.

The fellow of the great obelisk, which stood to the south of it, has been broken, and its fragments occupy its place. Beyond the great obelisk is the chief sanctuary, a structure almost entirely of granite, divided into two apartments, which was built under Philip Aridæus, in the place, no doubt, of one destroyed by Cambyses or Ochus.

The space between the hypostyle hall and this sanctuary is extremely ruined, the huge stones being piled up in heaps, as though an earthquake had overthrown the temple. But this destruction was probably due to human violence. Behind the sanctuary are fragments of a very ancient part of the temple, bearing the name of Usurtesen I., Dynasty XII. Considerably further is a large oblate building of the time of Thothmes III., which affords a remarkable example of architectural caprice, its columns having inverted shafts and capitals, and its cornices being likewise inverted. Behind this and a stone wall of inclosure are ruined chambers, and far beyond, directly behind the center of the great temple, in the crude brick wall of inclosure, is a handsome portal, never finished, bearing the name of Nectenebes II.

The southern approach to the temple of El-Karnak from that of El-Uksur is, as before mentioned, by a ruined avenue of sphinxes, which ends near the great structure, and two other avenues begin. The westernmost of these, which is of colossal rams, conducts to a temple situate not far to the southwest of the first court of the great temple; we approach it through a stately portal bearing in its inscriptions the name of Ptolemy Euergetes I. The front of the temple, before which was another avenue of rams, is a propylon, which is almost uninjured. Behind it is a court having a double row of columns on each side and at the end, and again behind this is a hall supported by eight columns and many small chambers. This temple was dedicated to Khuns, the third member of the Theban triad. It was begun under Dynasty XX., and continued by the high-priest kings. A small edifice, having sculptures of the time of the Greek and Roman rule, stands on the west of the court of this temple. The avenue of sphinxes, which branches off at the same place as the avenue of rams leading to the temple of Khuns, takes an easterly direction, and ends where another begins at right angles to it, which connects the southern courts leading to the great temple with a separate inclosure. The latter contains a lake, which has the shape of a horseshoe, and the remains of the Temple of Mut.

At the northern extremity of the avenue, which is of criosphinxes, is a propylon forming the front of a large court ending in a second propylon, which, like the other, is much ruined. Beyond this, but not in exactly the same direction, after a vacant space, the approach continues through two smaller propyla, the second of which is nearly destroyed. The first and second propyla were, like the criosphinxes, monuments of King Har-emheb, or Horus, of Dynasty XVIII., and were partly built of materials of a temple or palace of the sun-worshiping kings whom he overthrew. The third propylon is more ancient, for it bears the name of Thothmes III. and Amenophis II., as well as of subsequent kings; the age of the fourth is not certain; the name of Ramses III. occurs here, but it may have been founded before his time. There is an inclosure in the angle formed eastward by the third and fourth propyla with the great temple, which contains a sacred lake. Adjoining the great crude-brick wall of inclosure at its northeastern portion is another containing the ruins of an important temple. The chief approach is through a stately portal of the Ptolemaic period, in the crude-brick wall. The temple to which it conducts was very beautiful and costly, as we can judge from its remains, which show with how much violence it was destroyed. It seems to have been founded under Dynasty XVIII.

There are two small temples or chapels, one of the time of Acharis and the other of that of Nectanebes I. and II., in the same inclosure.

Another crude-brick inclosure of small dimensions, near the southeast corner of that of the great temple, contains some unimportant remains of a small edifice.

The brief description will convey some idea of the magnitude of the temple of Amen-ra at Thebes, with its appendages; but no one who has not seen that wonderful assemblage of ruins can picture to himself the massiveness of its castle-like propyla, the grandeur of its hall of columns, the beauty of its great obelisk, and the sublimity of its heaped-up ruins.

Of the city of Thebes there are scarcely any remains. Doubtless its edifices were of perishable materials.

THE GREAT TEMPLE.

The great temple of Ramses II., which may be called the Rameseum of El-Kurneh, but is commonly, though incorrectly, known as the Memnonium, is situate at a distance of about a mile to the westward of the Setheum, and is, like it, on the edge of the desert, which here is much farther from the Nile. Notwithstanding that its condition is much more ruined than that of other edifices of Thebes, the beautiful architecture of what remains, and the historical interest of its spirited sculptures, render it altogether second alone in its attractions to the great pile of El-Karnak.

A propylon, 225 feet in width, of which a great part has been thrown down, forms the front of the edifice. Through its portal we enter a spacious court 180 feet wide and 142 feet long. It had originally a double colonnade on either side, every column of which has been destroyed, while the side walls have been entirely demolished, and the end wall partially.

On the back of the propylon are sculptured a battle and other scenes of a campaign in the king's eighth year.

In this court is one of the most wonderful objects at Thebes, a colossal statue of Ramses II., broken in pieces, exceeding in its weight and equaling in its dimensions every other known Egyptian statue. It was of a single block of red granite, and must have been transported hither from the quarries of Syene, notwithstanding that its weight was, according to Sir Gardner Wilkinson's computation, about 887 tons 5½ cwt. (Modern Egypt and Thebes, ii., 144, 145.) It was sixty feet in height, representing the king seated on his throne, and was placed on the left side of the entrance to the second court.

Of that court, happily, there are more remains than of the first. Its width was about 170 feet, and its length about 140, so that it was not much smaller than the other court.

It had a double colonnade on each side and at the end, and but a single colonnade at the front. These were of columns having capitals of the form of the papyrus bud; except eight of the ten forming the front row, that is, all of that colonnade but the two extreme columns, and, in like manner, the corresponding ones of the opposite row, which were Osiridean pillars, formed of a square block, having in front a figure of Ramses as Osiris. Many of the columns and pillars have been demolished; but those which yet stand enable us to judge how magnificent this part of the temple must have been. On what remains of the front wall of the court, that is, on its northern half, are very remarkable sculptures.

To the southwest of the Rameseum of El-Kurneh, at a distance of less than half a mile, a mound just within the cultivable plain marks the site of a magnificent temple of Amenophis III., which may be called the Amenophium, and which, there is reason to believe, was destroyed by Cambyses. Of the obelisks and colossi which stood on either side of the approach of the Amenophium, all are thrown down except the two gigantic statues, one of which is known as the Vocal Memnon. The latter, indeed, was broken, but afterwards restored.

These colossi stand about a quarter of a mile to the southeast of the mound where are the scanty remains of the temple. They are of hard grit-stone, monolithic, and about 47 feet in height, with pedestals about 12 feet high. They represent Amenophis III. seated on his throne. Smaller, though colossal, standing statues of the king's mother, Queen Mut-em-ma, and of his wife, Queen Tai, rest against the space between the sides of the throne and the legs of the great statues, one at either extremity; while there are remains of two other statues of Queen Tai of smaller size standing between the feet of each colossus.

The colossi are little less than sixty feet apart, a distance judiciously chosen, so that they should neither seem smaller than they actually are, by being placed too far from each other, nor should be so near as to appear but a double statue.

PHILÆ.

Philæ is beyond the proper limits of Egypt, but as it is usual to describe it in noticing Asman and the rapids, some account will here be given of its very beautiful and interesting monuments.

The island is very small, being only a quarter of a mile long, and about five hundred feet broad.

On its granite rock is a little alluvial soil and some vegetation, with a few date-palms, but its verdure has been exaggerated, and to this it little owes its beauty. It was highly reverenced by the ancient Egyptians as a burial place of Osiris.

On the east side is a small but very picturesque temple, non-hypaethral, of the Greek and Roman time, and unfinished. It is 48 feet in width and 63 in length, and has fourteen columns, with capitals of various forms, connected by inter-columnal walls.

The great temple of Osis stands to the westward of this. Its front is formed by a propylon, before which is a kind of a court to be afterwards described. The portal bears the name of Nectanebes II., but the wings were added by the Ptolemies, making the entire width about 122 feet. Through the portal we enter a court, on the right side of which is a gallery fronted by columns, behind which are several small chambers, and on the left side is a separate small temple of Athor, the main entrance to which is by a door and passage in the left wing of the great propylon.

This small temple begins with a portico, having four columns with the faces of Athor sculptured in high relief upon each of their sides above the capitals. Beyond this are three chambers behind one another, above the door of the first of which is a Greek dedication by Ptolemy Euergetes II., and the two Cleopatras.

The temple was, however, begun by Epiphanes.

The court of the great temple, that of Osis, is bounded by a second propylon of smaller dimensions than the first, forming the entrance to the portico, which is a very elegant structure raised on ten columns, eight of which are at the back and one on each side.

It is partly hypaethral, an open space being left between the two columns last mentioned. The beautiful forms of the columns, and the bright remains of color on them and the walls, with the effect of the sunlight through the aperture of the roof, produce a charming effect.

Behind this hall are several small apartments, one of which, reached by a staircase, contains very curious sculptures relating to the story of Osiris.

The temple appears to have been begun by Ptolemy Philadelphus (whose name is the earliest found there), and was continued under the Roman emperors.

The court before the temple remains to be noticed. It is bounded by two galleries with columns in front. One of these is about 250 feet long, and is built close to the western side of the isle, terminating at a small temple of Athor near its southern end.

This edifice, which is much ruined, was supported by columns with faces of Athor above their capitals, of which six stand; it was raised by Nectanebes II.

The eastern gallery, which is shorter than the other, is not parallel with it, and thus shows that this court was not part of the great temple, but rather an approach to it.

THE PYRAMIDS OF EGYPT.

A WRITER in the SCIENTIFIC AMERICAN SUPPLEMENT, Feb. 19, asserts that the pyramids are "tombs, and nothing else."

But assertion will not stand against line and measure.

The circle of the earth's orbit around the sun is divided by nature into 365·24 days or parts. The diameter of this circle is equal to 116·26 such parts, and the side of a square of equal area with the circle is 103·033. Now, if you take one-tenth of this number, 10·3033, as your foot of so many inches and as your unit of measure, and multiply it by 886·23, you will have 9,131 inches, which is the base side length of the Great Pyramid according to the best measurements. Now, a square which has 886·23 feet to the side has an area of 785,403 square feet, and this area is equal to that of a circle whose diameter is 1,000, and whose circumference is 3,141·6 feet. We might reasonably infer from these numbers that those who built the pyramids were acquainted with the dimensions of the earth's orbit, and understood the squaring of the circle.

If you will measure all around the base of the Great Pyramid you will have 3,544·92 feet. 3·54492 is the diameter of a circle equal to a square whose side is equal to 3·1416. If you multiply 3·54492 by 0·88623 you will have 3·1416144516. If you take this last as your π number, 3·54492, divided into the circumference of any circle, will give the side of a square of equal area. 3·54492 is the side of the square of a circle whose diameter is equal to 4, the only circle whose area and circumference are expressed in the same numbers. This measure of 10·3 inches is the foot of the cubit of 20·6 inches, so much noticed by Sir Isaac Newton in the measurements of interior parts, and has a different derivation from the 20·7 cubit of Memphis.

But this was not the only standard used by the builders of the Great Pyramid. Good results are obtained by applying different measures to different parts.

Again, the axis of length of the King's Chamber is 412·5 inches. But this is the thousandth part of the diameter of a circle in terms of seconds.

Now, if you measure around the chamber in the same direction, you will have 1,296 inches; well, that is the thousandth part of the circumference of a circle in the same terms.

The builders were, then, acquainted with the circle of degrees.

These two measures—of the base side and of the chamber—should be sufficient to convince a mathematician that "though this be madness, yet there's method in it."

I will give a new etymology of the name "pyramid," derived from Egyptian words:

Pe—the heavens.
Ra—the sun.
Med—measure.
Peramed—the measure of the sun and of the heavens.

WATSON F. QUINBY.

Wilmington, Del.

DIGGINGS IN BŒOTIA.

DR. SCHLIEMANN and his wife have been staying for some time past in Bœotia, at the village of Skripa, near which they have been energetically pushing on excavations with a view to discover any remains of the prehistoric city of Orchomenos, the wealthy capital of the once famous kingdom of the Minyæ. Several shafts which Dr. Schliemann had sunk have afforded little result beyond a few relics of tombs, some vessels similar to those found in Mycenæ, and several inscriptions in the Æolic-Bœotian dialect. These Dr. Schliemann regards as of great value for Greek philologists. While Dr. Schliemann has been comparatively unsuccessful in the excavations under his own special superintendence, his wife, who has been conducting researches in another portion of the ground, has been fortunate enough to find what is believed to be the remains of the "Treasury of Minyas." In a letter to the *Ephemeris*, dated November 23, Frau Schliemann says: "About noon-day we came on a door and passage lying to the right of the treasury. At the end of the passage was a second door, leading apparently to a tomb or chamber, and barred by a stone tablet covered with beautiful reliefs." The government commissioner who is attached to the excavating party, writing of Frau Schliemann's discovery, says: "The door opens into a fine passage running in a northerly direction from the treasury. At a distance of three meters, however, lies a large stone which had fallen down from the roof and completely blocked up the passage. This stone is adorned with sculptured flowers, which may be taken as indicating that the decorated portion of the interior commenced here. The stone is rather more than four meters in length and two meters in breadth. The height of the door is not yet known; it is 1·3 meters in breadth." The remains of the treasury of Minyas lies at the foot of Mount Acontion, on the north bank of the Cephissus. The real nature and purpose of the monument are not known. Frau Schliemann thinks that the door now discovered leads to a second chamber, which was not known to the ancient excavators, and which, she thinks, may still contain treasures of very ancient date. The excavations

which Dr. Schliemann and his wife are prosecuting with great eagerness will soon set this question at rest.—*Builder.*

PIKE'S PEAK NOT A VOLCANO.

To the Editor of the Scientific American:

I have just seen in your SUPPLEMENT of Feb. 12, 1881, an article copied from the *Gazette* of this place about Pike's Peak as a volcano. It is all a *canard*—no truth in it whatever. You, of course, would agree with me that, in the interest of science and scientific information, it is wrong to originate such yarns and put them in such plausible shape. I never tire of gazing from my study window upon Pike's Peak, but I never saw any smoke or fire there, except the distant camp fire of some hardy prospector.

There has been a discovery, however, for which I can vouch, as myself and some of my Sunday-school boys were the discoverers, viz.: an extensive and wonderful cave at Manitou, near the foot of Pike's Peak. Forty or fifty rooms, some of them very large, have been opened. Wonderfully beautiful specimens of stalactites, flowering gypsum, etc., have been taken out. It is probably the finest cave in the Rocky Mountains, so far as is yet known. Would you care for a concise and brief description of it?

Colorado Springs, February, 1881. R. T. CROSS.

TANNIC ACID AS A PREVENTIVE OF FRILLING AND BLISTERS.*

FEW photographers who work with gelatine plates are so fortunate as to entirely escape the annoyance of blisters and frilling of the film, plates otherwise faultless being frequently utterly spoiled by the sudden and unexpected appearance of these troublesome defects.

The panacea usually recommended by makers of gelatine plates is a solution of alum applied to the plates before fixing. This application, however efficacious in preventing those blisters which make their appearance during and after fixing, cannot help us in avoiding the blisters which make their appearance during development, as any application of alum *previous* to development gives rise to markings on the film and uneven development.

Having during the past summer used a batch of plates for some instantaneous sea views, I was much annoyed by each one rising into innumerable blisters immediately the developer was applied. Plate after plate was tried, with the same result, and it was quite clear that I must discard the whole batch of plates or discover some means of prevention.

Thinking the matter over, the well-known action of tannin on gelatine suggested itself as a remedy. A solution of tannin was prepared and applied to the plate previous to development. This proved a decided success; the blisters had disappeared, and the remainder of the batch was developed, with scarcely a sign of either blister or frill.

As an illustration of the superiority of tannin in rendering gelatine insoluble, I have here three samples of leather, two of which are dressed by immersion in a strong solution of alum, while the third is tanned in a decoction of oak bark. On boiling the alum-dressed leather with a little water in a beaker a considerable amount of gelatine will be dissolved, forming a thick jelly in the glass; but by boiling the sample tanned with oak bark, no trace whatever of gelatine is to be found, the gelatine having been rendered entirely insoluble, and, in fact, converted into leather In like manner the tannic acid acts upon the gelatine plates, rendering the film insoluble, and so prevents the frilling and blisters.—*E. Brightman, in Br. Jour. of Photography.*

MODIFICATION OF EMULSION PROCESSES.

THE season is now at hand when the prudent photographer will endeavor to utilize the leisure that the winter's gloom places at his disposal, by making provision for the busy days which are expected to return with the finer weather of the coming spring.

Doubtless many a batch of dry plates will be prepared during the next few months, and stored away ready for use in summer, either in the professional studio or on the holiday excursions of the amateur. Indeed, this provision for the future is rendered almost necessary on account of the extreme difficulty which attends the successful preparation of emulsions during hot weather. It may, therefore, reasonably be expected that, from the multitude who will now be working the various emulsion processes, there will be no lack of practical suggestions for the modification of the somewhat tedious routine so universally recommended at the present time.

We do not assume, for one moment, that advantageous departures from the beaten track are possible, neither should we advocate the utility of attempting new methods for the sake only of differing from those which experience has proved to be the best; but the success which has already attended many attempts to simplify and to shorten the different manipulations suggests the probability that, before long, many of the operations which have hitherto been looked upon as absolutely necessary to success will be replaced by easier methods.

There are few who would not hail with delight any means of diminishing the length of time required for washing gelatine emulsion thoroughly, as well as of avoiding the somewhat troublesome details which must be attended to in order to perform even this most necessary operation with any amount of success; and we can but feel astonished that more should not have been induced to experiment with the idea (first suggested by Captain Abney) of washing the silver bromide previous to its incorporation with the gelatine.

Experience shows that by this means an emulsion can be obtained which, so far as its mechanical condition goes, is as perfect as could be desired; while it possesses the advantages both of obviating the necessity of a contact of silver nitrate with the gelatine, and, consequently, the chance of the formation of an organic compound of silver, as well as of being capable of being most perfectly washed, by the easy method of decantation, within the space of a few minutes.

It appears to be of importance, in this method, that the soluble bromide should be added to the silver nitrate solution, to which a small quantity of glycerine has been placed. Thus, during precipitation, the silver nitrate is continually in excess, and there is danger of the precipitation of other soluble compounds, owing to impurities in the soluble bromide. In this way sufficient oxide, or sub-bromide, might be formed to produce fog, on development, and it is therefore recommended to add a little nitric acid before washing the bromide.

Notwithstanding the simplicity and ease of this method, it appears to be but little adopted; but it so strongly recommends itself to those who have experienced the troublesome process of washing gelatine emulsion that it should at least receive a fair trial. There are, however, other means of simplifying the process of washing, such as the plan suggested by Dr. Van Monckhoven of decomposing silver carbonate by means of hydrobromic acid, which process requires considerable nicety of manipulation.

It is not improbable that other means than prolonged emulsification will be found for producing extreme sensitiveness; and it is impossible to over-estimate the advantage of such a modification, if we remember the serious evils which so often result from long cooking of the gelatine. Universal success, however, does not appear to have attended the addition of ammonia to the emulsion. Nevertheless, it is without doubt that increased sensitiveness may be obtained by such an addition.

It will be noticed, if a gelatino-bromide dry plate be partly wetted with dilute ammonia solution, and allowed to dry completely, that, on exposure to sunlight, darkening takes place much more quickly on the parts which were wetted than on the other parts of the plate. This would seem to prove that ammonia renders silver bromide less stable, and, consequently, more prone to decomposition by the action of sunlight.

Now, if an emulsion be prepared with a very large quantity of gelatine, the particles of silver will be so separated as to allow of their examination by means of transmitted light beneath a high power of the microscope. A comparison, by this means, of cooked and uncooked emulsion, conclusively proves that cooking changes the coarse irregular particles of silver bromide into excessively fine particles, which are evenly distributed throughout the gelatine. If, now, a drop of ammonia solution be placed upon the film, and the action watched beneath the microscope, it will be seen that the first action is a solution of silver bromide, together with some of the gelatine. As, however, some of the ammonia evaporates, the bromide is redeposited in a state of fine subdivision, and thus covers the plate with a new surface of freshly-precipitated silver bromide in a highly sensitive state, and possibly combined with ammonia.

It follows, as a consequence of this action, that it should be possible to increase the sensitiveness of a gelatino-bromide dry plate by flooding it with ammonia; and this we have found to be the case, although several precautions are necessary to insure success.

It is a matter which experience alone can prove whether such a simple means will be found to replace prolonged cooking; but it is at least likely that many a batch of plates, which prove slower than could be desired, might be improved by this means; and we certainly recommend experiments to be made in this direction.

Probably the effect of adding ammonia to the emulsion is similar to that which has just been described; and, although the process has as yet but few followers, we are glad to see that very successful results are being obtained by those who are adopting this plan. Dr. Eder has proposed to make use of the ammonia-nitrate of silver for adding to the soluble bromide instead of the nitrate, and already several successful modifications of this idea have been made.

But besides these modifications in manipulation, there is also another question of no less importance, viz., the use of the other haloid salts in conjunction with the bromide. Opinions are so diverse upon this point that it is still a matter of doubt in many minds whether the addition of iodide is beneficial or otherwise; but the facility with which the chloride is reduced in comparison with the bromide seems to point out that the addition of the latter is certainly not to be recommended.

Lastly, it must not be forgotten that, strong as may be the hold which gelatine has obtained among dry-plate photographers, there are other substances which have proved themselves capable of yielding important results; so that, while many will doubtless be following in the footsteps of Dr. Vogel's new process, there will still be left a wide field for experiment with other transparent colloids. But whether the coming season open out new paths or not, it is certain that, before long, there will be important modifications in those processes which are fast beginning to be regarded as stereotyped methods of working.—*Photographic News.*

* A communication to the Bristol and West of England Amateur Photographic Association.

INDUSTRIAL EDUCATION.

MR. JOHN S. CLARK, a member of the firm of L. Prang & Co., lately delivered an address before the Young Men's Christian Union, Boston, upon "Industrial Education Viewed from a Business Point of View." A large number of young men, with a small proportion of women, filled the hall. Mr. Clark's introduction emphasized the importance of education to national strength as well as to individual well-being. He spoke of the thorough training which is given in the schools of Germany, and said that its efficiency is found in the fact that only one per cent. of the population of the German empire is illiterate. Austria and England are also awakening to the need of a more general education. Education is defined either as training a person for the pursuits of adult life or for good citizenship—the latter definition including the former.

Mr. Clark had prepared a chart for the illustration of his lecture. Human activities were thus divided: Production—food, minerals, raw materials, industrial and constructive work; distribution—transportation, commerce, finance; education—literature, science, art, law, medicine, ministry; domestic service—protection of the social order, or the departments of civil service, army, navy, and police. A hundred years ago the department of protection was the most important in human activity. The government and its forces were of the most importance. But all that state of things has changed. Now the rights of the citizens are of the first importance, and the government has been relegated to the second place. Within a hundred years the industrial development of the world has been wonderful. Much intelligence has been expended in developing the industrial pursuits of men, and it is the brain and skill of men which transform rude and cheap materials into beautiful and valuable articles of manufacture. So it is that the industrial arts are given a higher place than agriculture. So we have this development, which is not the outcome of mere brute force, but the result of human intellect and skill. Mr. Clark held up two pieces of steel, one of which was worth but a few cents, whereas the other, though smaller, was worth $20. The added value came from the worth of the human thought which has been given to the article. Mr. Clark cited many instances to illustrate his point, that raw materials which cost but a trifling sum may be wrought into costly form by skilled hands and ingenious, inventive thought. A piece of iron which is worth $10, when made into horseshoes is worth $180; in cutlery, $6,800; in needles, $29,480; in buttons, $200,000; in watch springs, $400,000; in hair springs and in a yet higher form, $2,577,599. A few cents' worth of silk makes $10 worth of lace. Mr. Clark showed a point-lace handkerchief whose value was $80, yet whose material cost comparatively a trifle. A high-cost vase has in it but a few cents' worth of material. All the rest of the cost is in the thought and skill which are represented. In glass the same great addition of skill to the value of cheap materials is to be noticed. A creamer of gold and silver was displayed, the raw material of which cost only about $6, whereas the manufactured article is valued at over $50 in the current market.

To prepare the mind for actual industrial work, said Mr. Clark, it must know the physical and chemical nature of the substances which are used as material. It must have a knowledge of graphic and æsthetic art in order that the beauty, which is essential, may go out in practical expression. It must also have a knowledge of normal art, in order that the other knowledge may be expressed properly. In industrial work there are combined the elements of construction, representation, and decoration. The first has to do with the making of objects, the second with their appearance, and the last with the ornamentation of objects after they are finished. Mr. Clark had a large number of diagrams and sketches displayed before the audience, beginning with the simplest geometric forms and ending with a naturally colored landscape, and they were severally classified to illustrate what was said upon construction, representation, and decoration. There is hardly a conception of the human mind, he said, which cannot be accurately expressed in geometrical figures, strange as such a statement may appear. Decoration rests upon a study of nature, and in all the decoration of modern times no advance has been made beyond the principles established by the ancient Greeks. Several flowers were shown to the audience which had been made a study for the purpose of decoration. Mr. Clark held up a honeysuckle which had been studied so as to furnish a theme for a decorator. Its leaves had been in one case used as the chief figure in a very handsome border.

Speaking of manual art, Mr. Clark mentioned the various methods of manipulating into iron and wood so as to get the best use out of the material. This use can be found only by the addition of human thought and skill to the crude articles. He then spoke of the great importance of an industrial education, and of giving it to the people when they are young. Industrial pursuits are now leading all others. They are in the vanguard. But in the minds of our ablest educators there exists great confusion as to the proper course to be pursued. Educational development can be helped but little by the vague ideas of "culture," which are so widely entertained. Education is practically the development of brain power. Brains may be said to absorb knowledge, to assimilate it, to recreate it, and to express it. The real influence of a brain lies in its expressing power. The brain is best balanced in which the power of expression is the equal of the power of absorption. A brain is in a normal condition only when what it absorbs by the five senses is flowing out in a steady stream through the tongue and the hand. Mr. Clark reviewed the public school studies in this connection. The studies are largely on the absorbing side of the brain—such as reading, arithmetic, geography, grammar, history, languages, physiology, literature, natural history, and theoretic science. On the expressive side of the brain the only studies are speech and writing—wholly inadequate to the needs of the case, as Mr. Clark believed. It is hardly possible to get brains trained by such studies to work in industrial construction. They are fitted rather for work in distribution or in the professions, as tabulated in the first part of the lecture. Mr. Clark hung before his audience a chart which he thought would correct the evils mentioned. On the absorptive side he substituted natural science for theoretic science, and the consequence on the other side was development in drawing and the manual arts, a development, he thought, which affected the entire range of industrial education. The statement is too true that we have no educated American mechanics. No provision seems to have been made in our system for the education of mechanics. In the furniture factory of Brabrook & Co. only four of the fifty cabinetmakers are Americans; three of the four are employed on an inferior grade of work, and the other confesses his inferiority to the foreigners. The same fact is true of Geldowsky's workmen, and out of Paine's one hundred and sixty only sixteen are Americans. The trouble is that Americans cannot work from drawings. Nearly every workshop in the country witnesses the degradation to which American workmen are subjected. The only way in which Massachusetts can protect the interests of the people is by cultivating the application of brain-power to her industrial education. The best brain-power of Massachusetts has for years been steadily working away from her, leaving foreigners in its place. Mr. Clark closed with an appeal for a wider industrial education.—*Boston Advertiser.*

TANNING IN 1880.—A PAPER ON THE FIRST PREPARATION OF GREEN HIDES AND UPON MINERAL TANNING.

ONE of the most important industries connected with the general wants of mankind is, without doubt, the one that has to do with the manufacture of leather. In Europe and America not only does tanning keep in direct active work a numerous population, but indirectly a great number of individuals procure from this pursuit the means of support, either by the transport of the materials used in tanning, or by the sale and use of the articles made from the tanned leather. The rearing of the cattle, the salting of green hides, the drying of skins, and the bringing of them from America and the Indies into Europe; the stripping of the bark in the oak forests, the transporting and grinding of the tan, the manufacture of the tanning extracts, the making up into useful articles of the hair, etc., obtained from the skins, the construction of complicated machinery required in modern tanning processes—in fact, all the various industries that more or less are dependent on the work and progress of modern tanneries, are both numerous and important. As to the economic value of these various processes we shall perhaps not be saying anything that is not already known to many persons when we state that tanning, etc., stands third in rank in the great industries of the present day. Taking this as a recognized fact, and adding to it the many improvements introduced into this industry in recent years, we are led to say a few words upon this subject, though we do not think it necessary in this journal to launch out into special remarks upon any particular branch of it.

Leather, in some form or other, is met with in every branch of daily life, and every one knows the importance and desirability of having the same of a durable nature. Other journals, such as the *Leather Market*, for example, treat upon this subject in full detail, and the articles published in the above-named newspaper, under the title of "Leather

Everywhere," written by the late skillful writer, Leon Plée, were remarkably good, and excited the greatest interest in the public mind; and we think that the same articles would be of sterling value and highly appreciated if published in the form of a small book. We do not think it, however, necessary to say more about the numerous, and we might almost say the countless, uses of leather, as we consider the writer above named has treated this part of the subject so well and so exhaustively that we do not consider ourselves competent to say much more about it.

One of the most important questions in this industry is tanning in the strict sense of the word, that is to say, the particular operation by means of which the skins of animals are converted into durable leather.

From the most remote times even to the present day, vegetable matter, more particularly known under the name of tan or "tannin," has been used to accomplish the above transformation of the raw skin into tanned leather, and among the vegetable products used the bark obtained from certain kinds of trees, and even the leaves of certain plants, have played an important part in tanning operations. The material used varied according to the different kinds of trees, etc., found in the country where the tannery works were situated, but in all cases the tanning was effected through the absorption of the tan into the raw skin in such a way as to render the latter proof against natural decay, which almost everything is subject to. According to the thickness of the skin to be tanned and the nature of the tanning matter itself, the quantity and mode of employment of the same naturally vary, and the durability of tanned material consequently varies to a large extent when all things are fully considered. For instance, some skins require six weeks, others only a day, before the tanning of them can be thoroughly carried out; some even require two years' immersion in the tan pits to accomplish the work. This is one cause of the great amounts of capital sunk in this business remaining for a long time unproductive, and therefore there is little reason to wonder that a prudent tanner is cautious in making his purchases of skins and tanning materials, for this reserve is in a measure forced upon him by the force of such circumstances as we have above stated, and very often this state of things causes a tanner to be unjustly termed avaricious. A tanner is almost always obliged to pay ready money for his purchases, which by the nature of his trade have to be in the tan pit, etc., for a considerable time, and remaining for that time unproductive, while when the leather is finished he has to give a longer or shorter credit when he sells the same. We may say that of all industries the tanning business has to give the longest credit. This situation of things is not very pleasant to bear, and the respective position of the tanning business compared to other branches of industry in direct relation with it has caused the pursuit of it to be one of the most difficult in these modern times. At the same time, European tanneries have for a long time suffered, and even now suffer, from American competition, that causes to be sent to the various partsof Europe the surplus of badly tanned leather, which arrives here in great quantities, at a relatively low price—a price not resulting from the quantity or superiority in the quality of the leather imported, or from the easier production of the article, nor yet from the greater production of it, but rather from foolish speculations indulged in by Americans, who have forced their overplus leather into the European markets at any sacrifice of money and without having any regard to the disproportionate supply sent in.

Tanning operations may be divided into three principal classes, each one implying a certain number of peculiar manipulations, and the three classes may be named as follows: 1, stripping the hair, etc., from the raw hide; 2, tanning, properly so called; 3, sizing and necessary preparations.

We need in this article speak only of the first two classes.

The skins of animals which are generally used in the making of leather are not of a homogeneous nature, but are composed of a variety of layers formed of different tissues. The epidermis or outer skin consists of cylindric cellules pressed closely against each other. The outer portion of this gets dried and perishes through the influence of the atmosphere, while the interior layer of it, consisting chiefly of more inflated cellules, is more of a mucous nature. The hair has its seat in small cavities which are found in the epidermis, these cavities extending into the interior of the underlying layer of the hide, which layer is of the greatest importance to the tanner, for, strictly speaking, this is the future leather. This layer is composed of numerous fibers running parallel with each other on the surface of the green hide. By applying to the skins caustic lime or baryta in solution, these fibers are made to separate themselves more or less from each other, so far as to show that they consist of fasciæ of very fine fibers. These fibers are close together, nearer the outer side of the skin than the inner. Immediately under the inner side of the epidermis which bears the name of *corium*, there is a cellular subcutaneous tissue composed of loose cellules partly impregnated with fatty matter. This has generally, from the earliest days of tanning, been removed by the use of the knife.

The caustic alkalies, the alkaline earths, such as lime and baryta, and various acids, dissolve easily the epidermis, or at least its outer covering, and cause it to swell out the mucous layer.

The alkaline sulphurs act in a similar manner, and attack the outer layer, or what may be called the roots of the hair. Organic acids and most of the mineral acids swell the corium and cause it to absorb a great amount of moisture; this layer then appears as if very glutinous and almost translucid; it then attracts to itself a great deal of acid, and in being naturally dried it returns almost to its primitive condition, retaining, however, a tolerably strong portion of free acid. By various washings and macerations in water, the greater part of the moisture spoken of can be eliminated, but the hide always retains a portion of it.

When the skin is even on the animal it is impregnated with various liquid matters, which show themselves in an albuminous form when in solution or suspension in water. These liquids in the skin tend to isolate the fasciæ of fibers found in the hide, and in consequence the latter possesses the flexibility and elasticity that we find in it.

As soon as the skin is removed from the animal desiccation (drying) commences, the albuminous substances precipitating themselves between the fasciæ, and these fixing themselves together, the skin acquires the stiffness found in it, and finishes by drying itself altogether; and it becomes hard, breakable, and altogether deprived of flexibility. The effects of tanning consist, then, in replacing in the green hide a portion of the water and albuminous liquids by an antiseptic matter which takes their place, and isolates the fibers and fibrile fasciæ, and prevents them from ever again fixing themselves together, and at the same time preserves them from turning putrid; these materials may then be considered as the "tannin." The above effects may also be accomplished by the use of alum and other salts, by the employment of fatty materials, and others of which we will speak further on.

But to arrive at tanning in the proper sense of the word, the skin must be specially prepared to receive the "tannin." For this purpose, the subcutaneous fatty substance, which itself is a resistant to absorbency of the tanning materials, must be removed. This preliminary operation is accomplished by hand tools or by the use of appropriate machinery, and by such means the stripping of the hair, etc., is then accomplished. Formerly only two means were known to effect this: the use of lime or heat. The last operation brought on the commencement of putrefaction, which, acting upon the epidermis and roots of the hair, etc., loosened the tissues which held the former, and allowed the same to be removed with ease. Heat is chiefly employed to accomplish this in the manipulation of strong skins.

Lime under the form of diluted milk acts in loosening the epidermis and a portion of the corium, and in employing a solution of soap the fatty or fleshy matter found at the root of the hair and in the interior of the skin a calcareous formation of soap is formed, which is only removed with great difficulty. A too prolonged action of the lime changes a part of the hide into a substance somewhat analogous to soluble gelatine. The loss of this necessarily results in a loss of weight in the leather.

In order to shorten the action of the lime, sulphur of arsenic has for a long period been used with the former, this sulphur of arsenic being known by the name of orpiment. This substance is, as is well known, very dangerous, thus one can not but be astonished that it is still employed in the present day. Struck with the inconveniences and danger arising from the use of sulphur of arsenic, M. Felix Boudet, after a great deal of research, proposed in 1838 the employment of alkaline sulphurs, among others sulphur of sodium, sulphur of potassium, sulphur of barium, sulphurhydrates of lime and baryta, with or without the addition of quicklime, soda, and potass. M. Boudet took out a patent in France for the use of these materials for stripping off the hair, etc., but the wearisome routine work necessary was against the patent, and the sulphuric alkalines did not meet with a favorable reception. This clever man returned to the charge in 1859, and presented a report to the Paris Academy of Medicine, which recommended the replacing of sulphur of arsenic by the use of sodium. We may, therefore, be well astonished that the use of sulphate of sodium should have taken forty years to come into practical use for this purpose. In Germany this substance is now generally used for the purpose, several large manufacturers producing it at a price within the reach of all. We will state in a few words the mode of its preparation: The natural sulphate of baryta, in a pulverized condition, is reduced to the state of sulphur of barium by the use of charcoal and heat. The sulphur of barium in solution is then decomposed by sulphate of soda; from this sulphur a baryta of an extreme whiteness is obtained, which is used in painting, and also in the manufacture of paper under the name of "fixed white," and the liquid matter contains sulphate of sodium, which is made to crystallize by suitable evaporation. As we have previously stated, the sulphur of sodium with the addition of a little lime is now generally used by a certain number of tanners, while others who are obstinate in their prejudice against it, will not use it at all. There is now a great deal of talk of a new means of stripping hair, etc., from skins, which, according to what the newspaper called the *Halle aux Cuirs* says, has been extended in France. This new material is yet a secret, so that we can not now speak about it.

When the hides are stripped of their hair, etc., no matter by what means, and are washed and cleansed as much as possible (by fulling, the use of hydrochloric acid, etc.) from their alkalies and the lime they may still contain, the tanning operations are commenced. One preliminary operation is, however, necessary, and that is the inflation of the hides, joined to which is the commencement of the tanning, in very weak liquids. The swelling out takes place in liquids slightly acidulated, which predispose the hides to absorb in their capillary vessels the future tanning materials. Hides thus treated are then passed into liquids still stronger in tannic properties, until at last they are completely tanned; or, to complete the work, are finally placed in pits containing layers of hides and "tannin," valonia, etc. This last proceeding lasts a moderately long time. Attempts have been made to shorten the last-named process by many means, but the most radical innovation to effect this is that which has for its base the employment of mineral substances in place of vegetable "tannin." We know well that the strong partisans of leather tanned by the use of the ordinary "tannin" say that leather tanned by mineral substances is not leather in the strict sense of the word. It is true that the leather produced by the use of mineral substances does not yet possess in the same degree the properties to be found in leather made by the use of ordinary "tannin," and that, therefore, mineral-tanned leather has not yet come into general use; but this is not owing to its being tanned by the use of mineral substances, but rather to the fact that mineral tanning may still be said to be in its initiatory stages. Much progress has, however, been made in this mode of tanning, and everything leads to a hope that the difficulties still existing in the way will be overcome when tanners, in place of setting their faces against its use will on the contrary decide upon accepting from science what it has to offer in this direction, and by joining to it the fruit of their own practical observations, combined with the practicing of the system in their own tanneries.

The principal argument of the opponents of mineral tanning is that the product of such tanning is not a "chemical combination," while, according to their theory, leather made in the customary way is a real combination. In an article published on this subject in the weekly paper called the *Moniteur Industriel*, in the issue of the 1st of February, 1878, it is stated that leather made by use of ordinary "tannin" resists all attempts made to decompose it, and that this is not the case with mineral tanned leather. Ordinary leather, says the author of the article named, is made by means of a true "chemical combination;" we must say that he gives no proofs to support this dictum, but merely contents himself with making the affirmation, and he adds: "I will not stop here to demonstrate a thing which is so evident." We are willing to admit that the asserted statement may appear to him to be an evident fact; but as this is contrary to what is asserted by other equally competent authorities, it is to be regretted that the author, M. Munz, has not judged it advisable to name the reasons which have guided him to this summary assertion. He also says: "That which causes the resistance in ordinary made leather is that the skin is transformed into a new material in consequence of its combination with the 'tannin.'" This argument is decidedly a lame one, and, likewise, badly chosen, for the raw skin untanned, possesses a power of resistance considerably greater than what ordinary tanned leather possesses; besides, the leather known under the name of "crown leather" which is exclusively used in the manufacture of driving belts, possesses a power of resistance greater than ordinary leather, and this "crown leather" is tanned by the use of mixtures, in various proportions, of flour, fatty and albuminous materials, of salt and saltpeter, all of which are substances that do not enter into a "chemical combination" with the skin. The results of the comparative and direct experiments in regard to the power of resistance of different kinds of leather are named in the journal, the *Halle aux Cuirs*, of the 10th March, 1880. Without taking notes of these results the superiority of strength of untanned green hides over ordinary tanned leather is known to all practical men who have experimented upon the same. Besides, in what way does a chemical combination offer a greater resistance to wear and tear than a simple combination? If leather itself is a chemical combination it must be an extremely complicated one, considering the number of substances which are found in the composition of skin, more than what is to be found in "tannin;" moreover, it is well known that the strong portions of any very complicated composition are at the same time the most perishable, and this does not at all concord with durable qualities of leather.

Ordinarily tanned leather is not a chemical combination of skin and "tannin," and the following, among other reasons, cause us to say so. In a true chemical combination of two or more bodies, the substances constituting this combination lose two principal physical characteristics which are not discernible by the naked eye, nor yet when the latter is assisted by the use of a microscope. We will name only a few examples, which will no doubt make clear to persons not familiar with these questions what we state on this point. Iron oxidizes in moist air, that is to say, absorbs oxygen, and forms, by its aid, a chemical combination known by the name of oxide of iron or common rust. Can the ordinary physical qualities of iron and oxygen be found in this iron rust? Certainly not. Chlorine, one of the constituents of the iron rust, is an irrespirable gas, which is very corrosive, and is one of the constituents of common salt, of which it forms nearly 60 per cent.; the other constituent of the rust is sodium, a soft metal, which, when exposed to the air, is transformed into caustic soda. Can we find in this chemical combination the physical characteristics of the original constituent materials? Certainly not. We could name more examples on this point, but we think what we have given are quite sufficient to illustrate our remarks. We now beg to ask if, in the pretended chemical combination of the skin with the "tannin," the same conditions are fulfilled or not. A single inspection, at first with the naked eye, and then with a magnifying glass, and afterward with a microscope, will show that the organic structure of the skin is maintained even when the same is turned into leather, and it is owing to the maintenance of this organic structure of the skin that the leather is indebted for its flexibility and its resisting power; the parts of the leather which have undergone any chemical change, and, without a doubt, one of a chemical combination, are of a brittle character, and these non-tenacious parts are generally observed on the hair side of the leather, and when so discovered they are, without a doubt owing to the abusive use of acids or other matters, more or less corrosive. Then, the structure of the material is destroyed or weakened, a partial decomposition takes place, the hair side of the leather becomes brittle, and loses its organic form. Good tanning preserves those excellent qualities of the skin which are observed in it when on the animal, for before it is stripped from the latter it is flexible and strong, as much or more so than when combined with "tannin." The live skin is supple and flexible in every direction. Why so? Because it is impregnated with various liquids which keep all the fibers separated from each other and prevent them from fixedly uniting and thus forming a dry and hard covering. When tanning is carried out too roughly the fibers do not become sufficiently isolated from each other, and from this arises a hard and brittle leather. In well tanned leather all the fibers are well impregnated with "tannin," and owing to this all the fibers are in a manner isolated the one from the other, and consequently not one of them shows a weak point.

It can be seen with the naked eye, or with a magnifying or microscopic glass, that the structure of leather and that of the natural skin are the same in composition, and the great difference between them is the thickness, which varies according to the mode of tanning and the degree of impregnation of the "tannin." Besides this, the "tannin" found in leather possesses all the physical proportions of "tannin" when uncombined with leather; to prove the former we may say that the chemical properties can, by the aid of proper dissolvents, be all recovered from the leather and almost unaltered in their first properties. With regard to the physical properties of "tannin," we say that it gives to the leather a certain suppleness, the former being a hygroscopic body and one not liable to crystallize, and is to a certain extent soft and adhesive, which qualities tend to its condensation in the finest interstices of the skin.

It is often said that leather is a combination of gelatine and "tannin." Because gelatine can be obtained from skin, or rather because skin can be transformed into gelatine through the agencies of heat and water, many persons believe that the two substances—gelatine and skin—are identical. Now, this is not the case; even if the two bodies have a centesimal composition any way analogous, that is not to say that the two are identical, for the arrangement of the atoms or molecules of the two are different. The simultaneous action of water and heat produces a different arrangement or grouping that can be seen in many cases. Skin has a structure, but glutinæ has not. Skin requires a very prolonged ebullition (boiling) before it dissolves in water, and only dissolves after becoming gelatine and leaves a deposit, whereas the gelatine, mixed with cold water, dissolves with the least application of heat into a perfect solution.

Skin absorbs "tannin" without passing through the state of gelatine; gelatine simply swells out in cold water and does not absorb "tanuin," for it has no fibrous structure, and it is this structure, by means of its capillary attraction, which absorbs tannic solutions. Skin saturated with "tannin" is converted into a flexible production—leather; gelatine precipitated by "tannin" is a dry production, hard and brittle, and easily pulverized and clear of any organic structure; it may be a chemical combination, but this is very unlikely, and to ascertain it would require very exact verification. But some may now perhaps say: "How is it, since leather is not a combination, that skin absorbs 'tannin' so freely and retains it obstinately under ordinary circumstances?" Skin suitably prepared absorbs "tannin," by the simple action of dialysis, and tenaciously retains it afterward without combining with it; playing by that power of reten-

tion the same part that various other porous bodies play which have the power of attracting "tannin," coloring matters, etc., and retaining them with such tenacity that strong means have to be used to dislodge them. Animal black has so strong a power of retaining "tannin," etc., that to clear it from such it has to be boiled with caustic soda while very weak; cold alkaline solutions will also take away from leather the great part of "tannin" to be found in it.

In order to make leather, as I have before said, it is necessary to saturate the skin in substances which will prevent the fibers from closely fixing themselves together during the process of drying; these materials are numerous in variety, and the consequence is, the quality of the leather obtainable is variable; the substances that skin the most freely absorbs are alum and salts, the constitution of which is in a manner analogous, such as ferric acid, the chromics (alum of iron, alum of chrome, etc.), various salts of alum, besides alum itself, fatty matters, mixtures of flour and yolk of egg, the soaps of various metallic oxides, likewise the alkalies, solutions of stearic acid, resin, paraffin, etc. Almost all kinds of substance have been tried, and many of them have caused patents to be taken out to use them in some countries as a means of tanning in one or more of their forms. It is true that by the use of appropriate dissolvents these substances can be extracted from the leather, in the manufacture of which they may have been used, but this applies to the "tannin" to be found in ordinary leather. The fault that some apply to the use of oxide of iron in the making of leather is that by the use of mineral acids the oxide of iron can be separated from the leather. But this fault, if it may be called one, can with equal truth be applied to ordinary tanned leather, which loses its "tannin" when immersed in a weak solution of alkaline carbonates. Shoe leather is no more impervious to acid solutions than it is to alkalines. False statements on this point are of no value, and lead absolutely to nothing at all. Besides all this, the question upon which we speak is not one aiming to revolutionize the art of the dyer, but is merely a question upon the introduction of a new principle, which, far from supplanting the old one now so generally employed, seeks only to be allowed to be employed along with it. Hungarian leather, chamois leather, and crown leather—of which such splendid driving belts are made—are sufficient indications to show that it is possible for certain special purposes to cure leather by the use of other materials than ordinary "tannin." In these modern days patents have been taken out for tanning leather by the use of chromic compounds.

The first attempts made in the use of the latter were to tan leather which could not be employed for every purpose, but it appears that recent improvements in the use of the same mode tend to show that a very good leather in every respect can now be made by the use of a chromic compound. It is probable that leather thus made will be more adapted for driving belts than for boot and shoe purposes. Tests have been carried out as to the resistance to rupture of such made leather as compared with ordinary leather, and these tests have been in favor of the former. Whatever may be the attempts made to arrive at a perfect means of tanning by the exclusive use of mineral substances, it is evident that several more generations of tanners will pass away before this system comes into general use. The tests and researches made in this and other directions, instead of being a drawback to industry, are a real benefit, as they serve as a spur to further efforts. There is nothing sadder to notice than industries in which no signs of progress can be seen.—*Universal Engineer.*

THE SWILL-TUBS OF NEW YORK.

LAZARUS is sitting by the gate to catch the crumbs from the rich man's table, but the rich man prefers to throw them over Lazarus's head into the gutter, that they may feed the sewers of the town. Poor Lazarus in New York, and most likely in other large cities, has a bad time of it, if he depends on the crumbs; the swill-tubs and dust boxes take them in and transfer them to the dumping grounds. While Lazarus, with wife and child, gnaws the bones of yesterday's meal, the fat pieces are thrown out among the refuse and carried off by the Street Cleaning Department. Could not something be done with this constant extravagance of casting aside the pieces, which are clean and wholesome, for poor folks? We do not mean the broken scraps from plates, but the good morsels from unfinished meats. Many a hungry stomach might be filled, could but some plan be carried out to turn good remnants into healthy meats. Shall we ever forget the sight of some hungry women and children, who came daily at four o'clock to fetch from a certain place their share of the pieces, which had been sent from large business houses in locked up tins, that they might feed these needy ones? We do not wish to lower the poor man, woman, or child, but we say that the loss of what is wholesome and good is a crying evil in this hard weather. Many a rich house might with its waste find food for several hungry ones if a few places were fixed in New York where pieces could be sent to and then be given away, or what would be better still, be transposed into savory warm meals and be given or sold for little to the hungry and destitute.

Without fear or favor do we say: The swill-tubs of New York might feed its poor and leave something to spare.

The dust boxes are industriously searched by the Italian poor population before they can be removed, and may furnish many a meal, though it is not nice to think of the way such meals are got at; but how far more humane would it be were a certain plan of gathering carried out and were these remnants to come in a wholesome condition to poor people?

So little energy and exertion are needed to plan and carry out something of the kind, and yet it is so difficult to get at the right way. The old jog-trot way of doling out small coins or letting people starve, appears better than a clean apartment with a few tables, benches, and plates with nourishing food on them, which has cost no one anything but the cooking.

The heartlessness of great cities is proverbial, and is shown in nothing more than the utter neglect of means at hand to improve the condition of those who may after all but be sufferers from the conditions of our social system.

It is not only in the far away East in the beautiful parable, with a blue sky above and the warm air around, that Lazarus sits at the gate, sorrowing and suffering, but here in the proud metropolis of the United States that sends food out to millions abroad and yet cannot use up its own broken pieces to best advantage for the poor that sit at its gates waiting for the morsels which come not, but are in pure wantonness cast to the dogs, or worse still, on the waters of the broad Atlantic.—*Food and Health.*

THE phylloxera has thus far been discovered in vineyards in six counties of California, and it is feared that the spread of the pest may result from the very large shipments of grape cuttings.

THE PROPOSED TEHUANTEPEC SHIP RAILWAY.

By CHAS. W. ZAREMBA, Member of the Mexican Society of Natural History, etc., etc.

A FEW days ago the news was telegraphed all over the country that Captain Eads, the famous engineer of the St. Louis Mississippi bridge, of the New Orleans jetties, etc., had received very favorable concessions from the Mexican Government to build a ship railway across the Isthmus of Tehuantepec. For over fifty-six years the Mexican Government, as well as private parties, have busied themselves to connect the Gulf of Mexico with the Pacific Ocean by either a wagon road, railroad, or canal, or all of them, because, in the minds of enterprising men, such a problem was possible of solution and promising a profitable financial undertaking as well.

On November 4, 1824, the Mexican Congress ordered all the minutiæ in regard to the construction of a public highway on the Isthmus of Tehuantepec to be collected, and ever since more or less practical plans were presented to the Mexican Government, having the realization of this interoceanic communication in view. The first person really turning the first shovel of sod was D. Jose de Garay, who in 1842 had received the concessions for a canal across the isthmus, but various causes prevented his carrying out his plans. That such an undertaking was considered quite a boon for the United States was shown by a treaty between Mexico and the United States, entered into by D. Manuel Gomez Pedraza and Robert P. Letcher, on the 23d of June, 1850, and whereby the United States guaranteed the protection of this interoceanic highway by its army and navy. As the charter granted to Jose de Garay had become null and void by act of Congress of May 22, 1851, a mixed company, consisting of Mexicans and foreigners, was, on May 14, 1852, authorized to construct a canal, railroad, or wagon-road across the Isthmus of Tehuantepec.

On February 5, 1853, the Mexican Government approved a contract between the Secretary of the Interior and A. G. Sloo & Co., to connect the Gulf of Mexico with the Pacific Ocean by a railway, and using the Coatzacoalcos River as far as navigable. On February 19, 1853, the United States signed a treaty with Mexico by their representatives, viz., General Jose Maria Tornel and Alfred Conkling, declaring the interoceanic highway before mentioned neutral territory in case of war. The concessionists, however, did not come up to their agreement, and inasmuch as the Mexican Government was not disposed to abandon this project, on September 7, 1857, the Government granted a charter to the New Orleans Company, of Tehuantepec, which was worded about the same as all the previous ones, and somewhat modified on March 28, 1859.

The French invasion put a stop to this, as to many other public undertakings in Mexico, for about seven years, but on October 12, 1866, the unfortunate Maximilian signed a decree changing the name of the New Orleans Company, of Tehuantepec, to the New York and Tehuantepec Railroad and Steamship Company, with headquarters at New York. Three days later, on October 15, 1866, President Juarez signed a concession to the Tehuantepec Transit Company, granting privileges to construct a railroad and telegraph line from the beginning of the navigable Coatzacoalcos River to the harbor of La Ventosa on the Pacific coast. But like the rest, this charter was short lived, for on October 6, 1867, Emilio La Sire received a charter for the establishment of interoceanic communication by way of the Isthmus of Tehuantepec with the leading features of all previous charters granted. Chief engineer J. J. Williams commenced work on the Tehuantepec Railroad at Minatitlan, on January 24, 1871, and on May 22, 1872, the Mexican Congress passed an act authorizing the construction of a ship canal on the Isthmus of Tehuantepec. The changes in the management of this long-hoped-for interoceanic communication have indeed been manifold, for on December 11, 1878, H. H. Hall received another charter for the construction of a Tehuantepec railroad, and to close the year of 1880 Mr. Learned, of Pittsfield, received another charter for the same purpose. It is without my province to enumerate the various reasons for not accomplishing anything, so to speak, by these different railroad and canal companies, but I will confine myself to the last grant, viz., to Captain James B. Eads, and will give a concise

PANORAMA OF THE ISTHMUS OF TEHUANTEPEC

and the feasibility and advantages of a ship railway if built. The southern part of the State of Vera Cruz is called the District of Minatitlan, bordering on the north of the Gulf of Mexico, or rather the Bay of Coatzacoalcos, and, being divided on the south from the State of Oaxaca by that portion of the Andes called the Sierra Madre. From the mouth of the Coatzacoalcos River to the town of La Ventosa on the Pacific the distance in a straight line is one hundred and forty-three and a half miles.

Topographically the isthmus is divided into three principal parts, viz., the Atlantic plains, from the gulf to the foot of the Sierra; the second, or mountain district, in the central part; third, the Pacific plains is the level country bathed by the Pacific Ocean on the south.

THE ATLANTIC PLAINS

cover an area of some forty or fifty miles in width, near the Gulf coast, containing large and fertile valleys, traversed by the Coatzacoalcos, Tonala, Tancochapa, and San Juan rivers, and being on the average from two hundred to three hundred feet above the level of the sea.

THE SECOND OR CENTRAL PART

extends from the River Jaltepec on the north to about twenty or twenty-five miles of the Pacific coast, and embraces a tract of land of about forty miles wide toward the west, gradually widening to a breadth of seventy or eighty miles. The Andes Mountains suddenly diminish in height at the isthmus to such a degree that they are almost divided exactly in the narrowest part of the land between the Gulf and the Pacific ocean. The chains of mountains curving toward the northeast on one side, and toward the northwest on the other, with the concave facing the north, form a high table-land more or less broken by irregular and low spurs of the main Cordillera, and covering an area of some 1,400 square miles, being watered by the following rivers: Jumuapa, Sarabia, Malatengo, Almoloya, and Chichihun, all being tributaries to the Coatzacoalcos River. About half of these rivers are nothing but short torrents, and, on reaching the plains, pass over some portions of alluvial lands.

The elevated spurs or ridges above mentioned traverse the country generally from east to west, sending out smaller spurs, which gradually diminish in height. From the junction of the Sarabia River with the Coatzacoalcos to about two miles west of Boca del Monte and three miles to the southwest, there is a chain of high hills known as the "Montes de Sarabia."

The heights of Xochiapa, still further south, are divided by the rivers Malatengo, Almoloya, and Chichihun. Between these natural passes and the highest pass, the country is formed of rolling plains, generally presenting a smooth surface, occasionally irregular and undulating, and nearly bare of large trees, except on the margins of the principal rivers. These slopes rise gradually as they approach the upper pass, showing a more uniform level surface. They are bounded on the south by the Prieto, Masahuita, and Espinosa Mountains, which connect them with the chain of high mountains in the State of Oaxaca on the west, and the Cordillera of Guatemala on the east.

Through a narrow passage in these mountains we descend from the upper table-lands to

THE PACIFIC PLAINS,

which average about twenty miles in width from the foot of the mountains to the Pacific coast, with a grade varying from ten to fifteen feet per mile toward the lakes (Upper and Lower Laguna), forming an immense inclined plane at an elevation of only two hundred and fifty feet above the Pacific at the point where the inclination commences, with an even surface and gently sloping toward the sea.

These Pacific plains are traversed by eight rivers, of which seven empty into the lagunas, and the eighth river, that of Tehuantepec, coming from the northwest and passing through the town of the same name, empties into the sea at the Bay of La Ventosa.

The lagoons, which receive the greater part of their water from the southern slope, extend for nearly forty miles along the coast, covering an area of more than two hundred square miles; a narrow peninsula divides them in two principal sections, known as the Upper Lagoon and Lower Lagoon.

The Bay of La Ventosa is formed by an indentation of the coast and the projection of the Morro rock to the coast. The Tehuantepec River empties near this point.

This short description of the country will show that the uniting of the Gulf of Mexico, as proposed by Captain James B. Eads, and so elaborately explained in the SCIENTIFIC AMERICAN of December 13, 1880, by means of a ship railway, is not only feasible, but practicable, as far as land and water are concerned. The next question is

WILL IT PAY?

as no capitalist is willing to invest money in an enterprise where there is no probability of its producing a dividend in proportion to the cost of construction, repairs, and maintenance. It cannot be doubted that there is every probability that this undertaking will warrant such returns. The income will be derived from two sources—from foreign trade and the intermediate trade on the isthmus.

On looking at the map of the American continent it is clear that the Isthmus of Tehuantepec is the most favorable point for establishing an interoceanic communication regarding the United States, as well as America in general and Europe and Asia.

It is the shortest of all the actual routes from the United States or Europe, either now in operation or of any that are now projected. This is clearly shown by

A TABLE OF DISTANCES

from England, New York, and New Orleans, to San Francisco, by the way of Panama, Nicaragua, and Tehuantepec, compared with the routes for the same places by Cape Horn, as it also shows the distances that are likewise saved by traversing the American isthmus:

To San Francisco from—	By Cape Horn. Nautical Miles.	By Panama. Nautical Miles.	By Nicaragua. Nautical Miles.	By Tehuantepec. Nautical Miles.
England	13,628	7,502	7,041	6 671
New York	14,194	4,992	4,531	3,804
New Orleans	14,314	4,505	3,767	2,704

Saved from—	By Panama. Nautical Miles.	By Nicaragua. Nautical Miles.	By Tehuantepec. Nautical Miles.
England	6,122	6,583	6,953
New York	9,202	9,663	10,390
New Orleans	9,809	10,547	11,610

These are not mere theoretical figures, but compiled from actual logs of the various established steamship lines. If Captain Eads' scheme should be realized, the exchange of merchandise between the Pacific coast north and south would be carried on nearly at the mouth of the Mississippi. Another item of great importance must not be lost sight of, and that is

THE CLIMATE.

During many months of travel in that part of the country, camping out at night in the open air, no chills, dysentery, or malignant fevers were contracted, but, on the contrary, the salubrity of the atmosphere, the purity of the water, and the magnificent scenery of the isthmus, exercised a most invigorating influence upon the whole body. The rains on the isthmus are not of sufficient consequence to prevent outdoor work for the whole of any day; the mean temperature ranging from 62 degrees in January to 98 degrees in May. The profusion of the myrtle and laurel families of plants growing on the isthmus is a proof that the temperature is not tropical but sub-tropical. The highest temperature on the Pacific plains is softened down by the breezes which blow off shore and from the mountains.

From the northern shore on the Gulf to the base of the Sierra on the south,

THE VEGETATION

is that found arising from the alternating influences of heat and moisture. On all the rivers are seen huge specimens of the most valuable trees of the equinoctial regions, mingled with many varieties of palms, gracefully towering above plants of the most dense and impenetrable foliage, whose masses of verdure sweep the current at every sinuosity. Under these circumstances the view which is presented to the eye is often of the most enchanting nature.

Remote from the River Marquis, the limit of the periodic overflow is more particularly marked by the presence of plants which are of a fine and cellular tissue, and by trees of greater value.

A faint idea of the richness of vegetation on the Isthmus

of Tehuantepec can be formed from the following number of

VARIETIES OF TREES AND PLANTS

used for various purposes:

72 varieties of trees used for building, construction, etc.
8 varieties of trees used for tanning, etc.
18 varieties of trees and shrubs used for dyeing, flavoring extracts, etc.
24 varieties of trees and shrubs used for gums, oils, balsams, etc.
16 varieties of trees and shrubs used for textile fabrics, cordage, etc.

THE GEOLOGICAL STRUCTURE

of the Isthmus of Tehuantepec is less clearly defined than that of more elevated districts in Mexico. A country that extends one hundred and thirty-five miles horizontally from ocean to ocean, with an average elevation of six hundred feet, cannot present on the surface many exposed places where the dip, strike, and nature of the rocky basis could be ascertained; much of the gentle slope of the

ATLANTIC PLAINS

being covered by clay, sand, and gravel, and so densely wooded that no appearance of the rock formation is discernible. The same may be said of the plains on the southern shore. In the central and more elevated regions the conformation is more evident; and what is hidden upon the hillsides, owing to the superficial deposits of gravel and sand, has been in great part exposed by the sections made by nature in the mountain passes.

The tertiary clays, gravels, and beds of detritus, which cover up so much of the isthmus on the surveyed route, extend on the north side almost to the summit level and to the base of the hills which lie east and west of it. These deposits being found pretty uniformly spread, even to the depth of thirty feet in some places, as at a point north of the summit level, and between it and the River Almoloya, are evidences of the slow and easy elevation of this portion of the isthmus above the sea, and of a comparatively quiescent condition since a very distant epoch.

Granite and granitiform rocks do not occupy much extent of surface upon the isthmus, and perhaps were not the chief upheaving agents which elevated this district. Porphyritic, dioritic, and greenstone rocks appear in the majority of cases to accompany the most vertical of the stratified rocks, and to have been, by their intrusion and appearance upon the surface, the elevating rocks. This crystalline rock (granite), however, does appear in a few places; it is first met with on the Pacific shore, where it constitutes the Cerro Morro, Huilotepec, San Diego, and extending north to the City of Tehuantepec, where it appears in the hills of Dani Guivedchi and Danilieza. These small hills, which are not over five hundred feet above the plain, or five hundred and fifty feet above the sea, are the eastern spur of a small granite range (the Cerro Verde) which passes in a westerly direction through the State of Oaxaca toward the Rio Verde. On widening toward the west they become more elevated.

The scattered hills which lie along the shore between this range and the lagoons, such as Malamamlaif and a few of lesser note, are the most depressed points of this chain. Granite forms some of the higher summits in the mountain districts north and northeast of Cerro Atravesada. It is also met with to a small extent in the low ground leading from the Portilla de Tarifa to La Venta de Chicapa, along the Arroyo del Tolistoco. This rock is not met with in any other part of the isthmus; drift and pebbles of it are found in the channel of the Coatzacoalcos River, carried down from the Sierra by the mountain torrents, showing its existence in that range.

With one exception, all the islands of the Upper Lagoon, and the hills which lie between it and the Lower Lagoon, are of greenstone, sienitic greenstone, with other metamorphic rocks, such as porphyry and hypersthene. The greenstone here appears to have cut through the granitiform rocks and their contents, and the constituents of both seem to have become fused together.

THE PRINCIPAL RIVER

of the isthmus is the Coatzacoalcos and its tributary, the Uspanapa. The first is about one hundred and forty-three miles long, and navigable for vessels of heavy draught a distance of thirty miles from its mouth, and for smaller craft to very near the upper part of this stream. The Uspanapa is narrow, but has plenty of water and is navigable a great distance from its junction with the Coatzacoalcos. An infinity of other streams join the former, and many are navigable for some distance.

After having shown the conditions and advantages derived from interoceanic communication on the Isthmus of Tehuantepec, I will finally mention the ports or

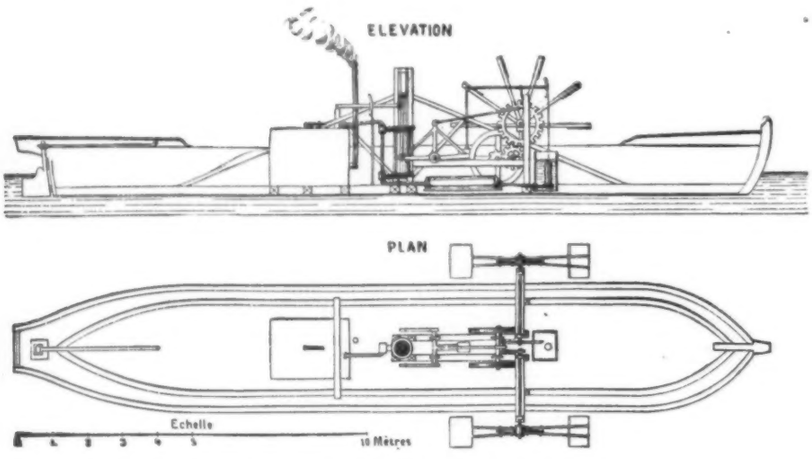
HARBORS ON ITS COASTS,

the facilities for the entrance, anchorage, and safety of vessels—as without these requisites the projected communication would only be an idle dream.

The port of Coatzacoalcos is one of the best on the Gulf, having better anchorage ground than Vera Cruz; the bar has fourteen feet of water, with very little surf; passing over the bar, the harbor is from six to eight fathoms deep. The port of La Ventosa, unlike all the other ports on the Pacific coast from Punta Desolada on the north to Cabo Velas on the south in Nicaragua, a distance of some two hundred miles, and parallel to the lake of this name, is not visited by those terrible winds called "papagayos," which make the approach to the port of San Juan del Sur (Nicaragua Canal route) exceedingly difficult. These winds are supposed to be caused by the general northern trade winds, which sweep entirely across the continent and Lake Nicaragua and encounter other atmospheric currents on the Pacific. These latter trade winds are strongly felt, and blow off the shore some fifteen to twenty miles, beyond which the conflicting or revolving winds, or "papagayos," commence.—*Chicago Evening Journal.*

FULTON'S FIRST STEAMBOAT.

JACQUES DE VAUCANSON was a French mechanician who was born in Grenoble, Feb. 24, 1709, and died in Paris, Nov. 21, 1782. He studied mechanics and anatomy for several years. The statue of the "Flute Player," in the gardens of the Tuileries, first suggested to him the project of making an automaton player, and he acquired great celebrity by works of that class. Cardinal Fleury appointed him inspector of silk manufactures, and in consequence of his improvements in machinery he was attacked by the workmen of Lyons; but on these he retaliated by constructing an automaton ass weaving flowered silks. He bequeathed his collection to the queen, who gave it to the Academie des Sciences; it was afterward scattered in consequence of a contest with the mercantile authorities for the possession of the manufacturing machinery. His portfolio, containing drawings and documents of great historical value, is now in possession of the Conservatoire des Arts at Metiers, at Paris. Perhaps one of the most valuable things in the collection is Fulton's design for his first steamboat, accompanied by an autograph letter. We present herewith a facsimile of this drawing,



FULTON'S FIRST STEAMBOAT.

(Plans reduced from the inventor's original drawings, now in Paris.)

which was reproduced by *La Nature* from the original. Fulton's letter, which was written in somewhat defective French, reads as follows:

PARIS, 4 Pluviose, Year 11 (1803).

Robert Fulton to Citizens Molar, Bandell, and Montgolfier, Friends of the Arts:

I send you herewith drawings sketched from a machine that I have had constructed, and with which I purpose soon to make experiments in causing boats to move on rivers by the aid of fire pumps (*pompes à feu*). My first aim in occupying myself with this idea was to put it in practice on the long rivers of America where there are no tow-paths, and where these would scarcely be practicable, and where, consequently, the expenses of navigation by the aid of steam would be placed in comparison with that of manual labor and not with that of horse power as in France. . . . . In these drawings you will find nothing new, since they are only (those of) water wheels—a method which has been often tried and always abandoned because it was believed that a purchase could not be thereby obtained in the water. But after the experiments that I have made I am convinced that the fault has not been in the wheel, but in the ignorance of proportions, velocities, powers, and probably mechanical combinations. . . . Citizens, when my experiments are ready, I shall have the pleasure of inviting you to witness them; and, if they succeed, I reserve to myself the privilege of either making a present of my labors to the Republic, or deriving therefrom the advantages which the law authorizes me to. At present, I place these notes in your hands, so that if a like project should reach you before my experiments are finished, it may not have preference over my own.

Respectfully,

ROBERT FULTON.

The first steamboat constructed by the great inventor was damaged by a sudden squall, and it is said that he set to work with extraordinary ardor to replace it with his own hands. Fulton's boat navigated the Seine for the first time on Aug. 9, 1803, in the presence of a large crowd of persons, who displayed great enthusiasm at the novel sight.

WATER made slightly salt, and to which bran in the proportion of one quart to every gallon has been added, is said to increase the yield of milk 25 per cent., if it is given to cows as their ordinary drink.

CALVERT STREET BRIDGE IN BALTIMORE.

THE following is a fuller description of this bridge, of which we published engravings in our SUPPLEMENT, No. 272.

The bridge, starting from the south end, consists first of one span across Jones's Falls of 116 feet between pin centers, thence of 196 feet of viaduct of spans of about 20 feet across the valley; thence of one span of 145 feet 10 inches across the railroad tracks, and thence of 115 feet of viaduct reaching to the north abutment. The total length of the structure is 575 feet; breadth over all, 62 feet. The spans are of the bow-string girder form, entirely of wrought iron with the exception of the bed plates and chairs. The arc is formed of plates and angles bent to the proper curve, and latticed, and is made continuous by riveted joint plates. The chord is of eye bars. The posts, which are really tension members, are built of latticed channels, and being riveted firmly to the floor beams, assist in giving lateral stability to the arc at each panel point. The panel ties are flat eye-bars swiveled. The floor beams are plate girders. The 116 feet span has a skew of 7° 50′, and the 145 feet 10 inches span has a skew of 32° 45′ from a right angle. The two sections of viaduct are alike in character, consisting of plate girders resting on cast-iron columns, which are based upon and bolted to cut stone pedestals. The panel ties are flat eye-bars swiveled. The floor beams are plate girders. The 116 feet span has a skew of 7° 50′, and the 145 feet 10 inches span has a skew of 32° 45′ from a right angle. The two sections of viaduct are alike in character, consisting of plate girders resting on cast-iron columns, which are based upon and bolted to cut stone pedestals. The masonry is first-class coursed work of gneiss with granite string courses and coping. It consists of two hollow abutments, three piers, and forty-three pedestals. The floor is composed of rolled beams covered with buckled plates, upon which is laid the solid asphaltum roadway, the average thickness of asphalt being on the spans 5¼ in., on the viaduct, 6¼ in. The asphalt was put down in three layers, the first being a leveling layer to cover the buckled plates and T-bars, about 3 in. thick; then the second and final layers were put on, each being rolled in turn by a five-ton steam roller. This floor, after four months' constant use, is in very fine order. The solid asphaltum floor was adopted on account of its elasticity and capability of adjusting itself to the expansion and contraction of the iron work; it is not continuous over the entire length of the structure, but is broken into four separate sections, one for each span and one for each viaduct. The ends of the arched ribs are covered with pedestal castings, surmounted by lamp pillars carrying bronze lamps. The capacity of the structure is 100 lb. per square foot of floor surface, in addition to its own weight. The total weight of the iron in the bridge is 2,500,000 lb.; total amount of masonry, about 7,500 cubic yards. The ends of the abutment wings are surmounted by granite pedestals, upon which are to be placed the figures of lions, guarding shields carrying the city arms.

Everything has been done in the most substantial manner and with a view to permanency. The total cost of the structure was $219,000.—*Railroad Gazette.*

THE WASHING OF FINE OR PULVERIZED COAL.

WE represent opposite, in Figs. 1, 2, and 3, an arrangement of machinery devised by the Humboldt Machinery Works, of Kalk, near Cologne, for washing fine or pulverized coal. As in certain cases it is found that washed fine coal contains less ashes than grate or chestnut sizes, and that the latter, with 12 to 14 per cent. of schist, are not very salable, the Humboldt works has studied out the present plan for the exclusive treatment, mechanically, of fine or pulverized coal.

The coal arriving at the washer is thrown by the dumping apparatus, A, upon a grating, B, constructed according to Briard's system. The refuse from this grating (20 per cent. large size + 15 per cent. grate size) slides down on to an endless-chain carrier, C, from which are picked off by hand all particles of schist, while the pure coal is carried forward to the wagons, D, in waiting. The height of the wagons determines the inclination of the carrier, the position of which, under some circumstances, may be horizontal. In the majority of cases, those pieces which do not pass through the grating (the bars of which are 1·4 to 1·6 inch apart) is picked out by hand and sold as large grate coal. All the coal which has traversed the grating is carried up by chain and buckets to a classifying separator, F.

The coarse refuse from the latter falls on channeled crushing cylinders, G, and returns pulverized to the same chain and buckets, E. By this means all useless crushing of the coal is avoided. The separator is perforated with holes of from 0·25 to 0·3 of an inch in diameter and the siftings which issue therefrom fall into a reservoir, H, filled with water, and afterward enter a system of precipitating vessels, L′ L″ L‴. The water required for washing is supplied by the pump, J, from the pipes, K. The matter precipitated at the bottom of the vessels, L′ L″ L‴, is a mixture of schist and coal, which is afterward thrown on inclined sieves, M. At the last precipitating vessel the current of water should be reduced to a minimum, in order that only a very minute part of the coal may be drawn toward the clarifying basins, N, where it is deposited as mud.

All of the washed fine coal falls into the reservoirs, O, beneath the sieves, from whence it is carried up by chain and buckets into the storage chamber, Q. During its ascent the water drains away through holes pierced in the bottom and sides of the buckets. A like operation is undergone by the schist. Having been collected in the reservoirs, O^1, a chain and buckets takes it up and carries it to a room, Q^1. The overflow of the reservoir, O^1, flows into a drainage-well, U. The clarified waters of the basins, N, and of the wells, U, return to the well from which the pump, J, is supplied. When sufficient clear water is at the disposal of the works, the whole or a portion of the clarified waters in the reservoirs, N and U, may be dispensed with.

To operate an establishment of this kind, capable of treating 25 to 30 tons of coal per hour, there is required a motive power of from twenty to twenty-five horses. Two main shafts, W, and two counter shafts transmit motion from the engine to the various apparatus. Supposing the boiler to be heated by the waste gases of coke furnaces, and that three workmen (besides the wagoners) are employed—one for attending to the engine, one for working the sieves, and one for carrying off the schist and cleaning out the basins, the cost (estimated for France) of working 200 to 250 tons per day is about $8.00, and this includes interest on the capital invested in the buildings and machinery, as well as wear and tear

SEVERAL changes in the summit of Mount Etna have been observed by Prof. Silvestri since the last display of volcanic activity. The summit is now 3,300 meters above the level of the sea, the height having decreased 12 meters; the interior edge of the crater has increased from 1,500 meters to 1,800 meters, and the eruptive axis, which was before the eruption of 1879 on the west side of the crater, is now right in the center.

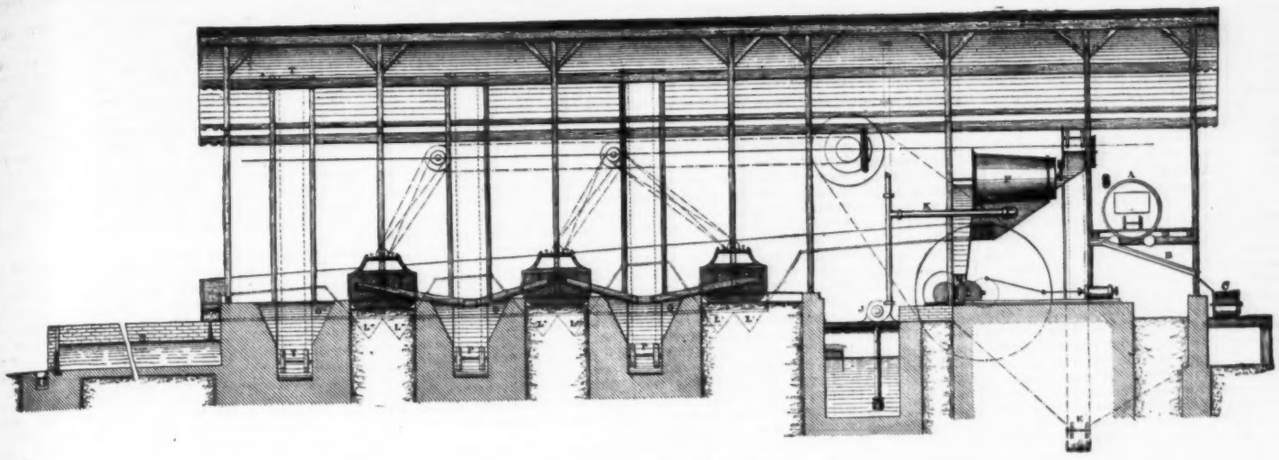


FIG. 1.—LONGITUDINAL SECTION.

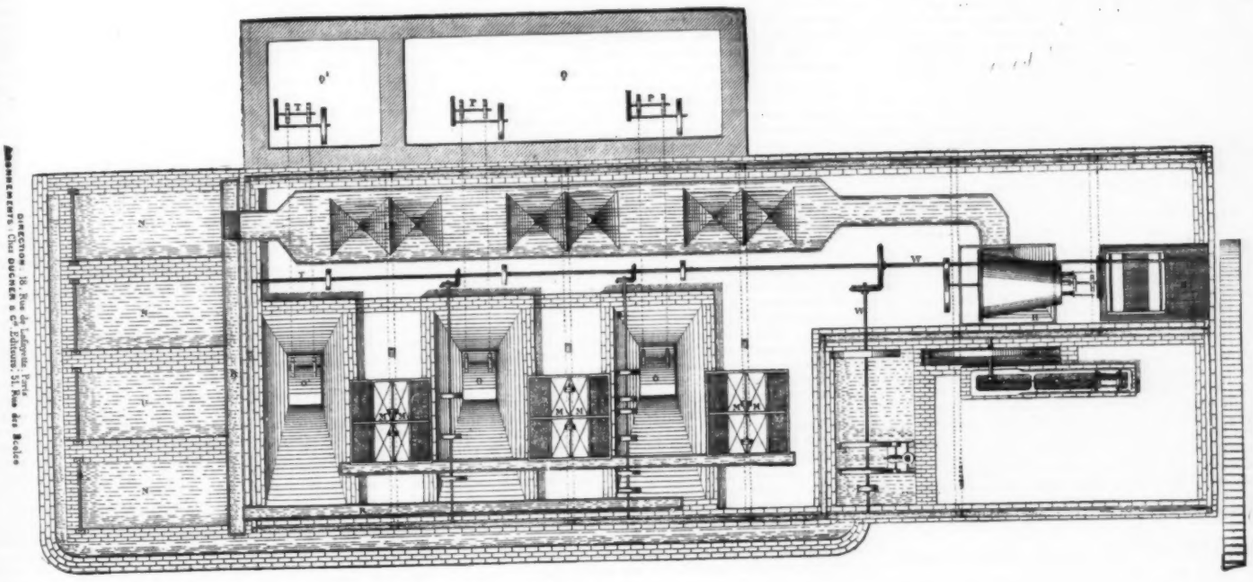


FIG. 2.—PLAN.

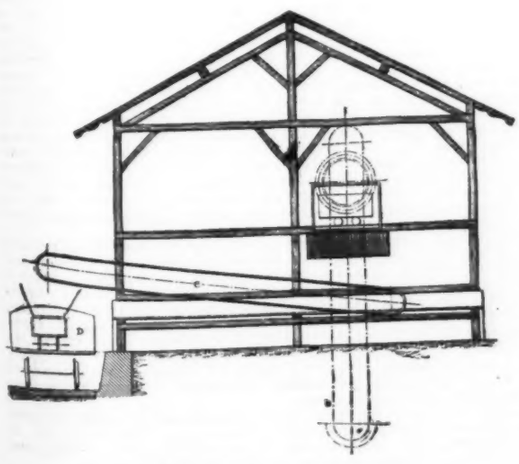


Fig. 3.—VERTICAL END VIEW.

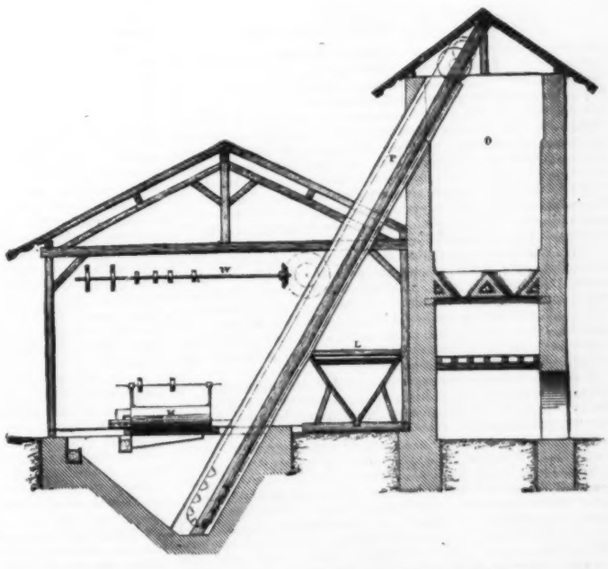


Fig. 4.—TRANVERSE SECTION THROUGH MIDDLE.

MACHINERY FOR WASHING PULVERIZED COAL.

ON THE THERMAL BALANCE.*

By PROF. S. P. LANGLEY.

WHEN the thermometer is not sufficiently sensitive for delicate investigation of radiant heat, scientific men have been accustomed, since the time of Melloni, to the use of the thermopile, an instrument which, employed in connection with the galvanometer, permits the making of numerous important measures. It has not been improved materially in the last fifty years. Meanwhile, many problems of both high theoretical and practical interest have arisen, which cannot be solved without a more sensitive and accurate instrument. One of these problems is the measurement of the distribution of radiant energy in a pure spectrum, when the rays have not passed through any prism. I could obtain no accurate results with the thermopile. I was forced to invent a more sensitive instrument for this special investigation, and, having done so, I believe it will be of general utility. The principle of the new apparatus has been applied by Dr. Siemens and others to other purposes. I spent several months in making it, as I hope, a useful working tool for the physicist and the physical astronomer. It is founded on the principle that, if a wire conveying an electric current be heated, less electricity flows through it than before. If two such wires, carrying equal currents from a powerful battery, meet in a recording apparatus (the galvanometer) the index of the instrument—pushed in two opposite ways by exactly equal forces—will remain at rest. If one current be diminished by warming ever so little the wire that conveys it, the other current causes the index to swing with a force due, not directly to the feeble heat which warmed the wire, but to the power of the battery which this feeble heat controls.

The application of this principle is thus made: Iron or steel is rolled into sheets of extreme thinness. I have succeeded in rolling sheets of steel made at the works of Miller & Parkin, Pittsburg, Penn., until it took 8,000 of them to make the thickness of an inch. Of the platina sheets rolled at the United States Mint in Philadelphia, fifty laid one on another do not together equal the thickness of light tissue paper. Minute strips of these, one-thirty-second of an inch wide and a quarter of an inch long, were united so as to form a prominent part of the circuit, through which a part of a powerful battery passed to the galvanometer. Experiment proves that an almost inconceivably minute warming of a set of these strips reduced the passage of the electricity so as to produce very large indications on the registering instrument. I have in the course of my experiments thus far found iron the most advantageous, though other metals are still under trial. The instrument thus formed is from ten to thirty times more sensitive than the most delicate thermopile; but this is almost a secondary advantage compared with its great precision and the readiness with which it is used. The thermopile is very slow in its action. This new instrument, the thermal balance, takes up the heat and parts with it again in a single second. It is almost as prompt as the human eye itself.

With reference to its accuracy, experiments prove that the probable error of a single measurement made with the instrument can be reduced to within one per cent. of the amount to be measured. It will register a change in the temperature of the strips just described, not exceeding the fifty-thousandth part of a Fahrenheit degree. When mounted in a reflecting telescope it will record the heat from the body of a man or other animal in an adjoining field, and can do so at great distances. It will do this equally well in the night, and may be said, in a certain sense, to give the power of seeing in the dark. A more valuable proof of its efficiency is shown in a series of measurements of the heat of the moon, made under varied circumstances, to guard against error, but each made in a few seconds. All these measurements show that the almost immeasurably minute amount of heat from the moon can be certainly measured by it, even with a common refracting telescope.

RECENT STUDIES AMONG THE STARS.†

By PROF. ISAAC SHARPLESS, of Haverford College.

PERHAPS the prevailing ideas which a person has when he gazes at the heavens, carelessly, as most of us do, are uniformity, except as to brightness, stillness, and silence. He considers that the stars are similar points of light differing only in brightness; that they rest, absolutely devoid of motion; and that

> "No real voice nor sound,
> Among those radiant orbs is found."

But they are all false ideas. There is as much diversity as in the trees of the forest. They move with velocities to which that of the rifle ball is feeble, and in the course of the performance of their duties sounds and crashes are evolved by the side of which the thunder of the loudest artillery would be unheard and the terrific throes of the earthquake be gentle intonations. To hear these sounds and see these motions with the mental senses requires the command of instruments not easily obtainable; but to notice this diversity one has only to point a very feeble glass at the stars to recognize the vast divergence from any fixed type that exists among them. Sometimes a star, single to the eye, becomes double or triple or multiple in the glass; sometimes a haze of light becomes transformed into a cluster of hundreds of stars, the red and the green and yellow and blue mingled together, forming a most brilliant combination; sometimes there passes through the field of view a nebula, round or elongated or ring shaped, or looking as if a whirlpool had caught and twisted it into a vortex of light bands; and sometimes there is only a bewildering multitude of points of light of uniform brightness of color.

Let us go over the constellation *Orion*, now shining in its incomparable brightness high up in the southern sky. You easily remember the bright star in each shoulder of the old hunter, the three little ones in the head, one row of three in the belt, and another in the sword, the brilliant *Rigel* in the knee, and a score or so of less marked stars scattered about around these; and that is all you probably see in it. But take a glass of only three or four inches aperture and study these stars separately. No two are alike. *Betelgeuse* in the right shoulder is, according to one astronomer, "a brilliant gem, a rich topaz in hue and brilliancy, differing from anything I have seen." If you watch it long enough you will notice it to be variable, sometimes the brightest star of the northern hemisphere, sometimes far below *Rigel* in the foot. *Rigel*, if you study it carefully, will be seen to be double, itself yellow, and its companion blue. The top star of the three in the head is a triple, with distinct differences of color. The three in the belt are all double, and all vary in distance and color. The star *Sigma*, just below the belt, is made up of eight components, a most complicated system. The middle one of the three in the sword is easily seen quadruple, and a larger glass shows four or five small stars among these. On a moonless night a haze will be seen around these with the naked eye, and any telescope shows there the famous nebula of Orion, unresolved and irresolvable. There is nothing in the heavens more striking in appearance than this group; the hazy outline of the nebula stretching out in irregular bands and patches, like some great monster with the dark spot in the center, near which are set the four stars forming the famous trapezium of Orion. These four stars form a single system, revolving about each other and sharing with the nebula a common motion of rotation. All around this are curiosities scattered plenteously; just above is a cluster of faint stars; below is another double involved in nebulosity; while fainter nebulæ, double and multiple stars, are aggregated here in profusion.

But we have studied far enough. There is identity in stars. There is endless variety in star attributes. The uniformity that strikes us as we gaze upward changes to complexity and confusion as we extend our studies. In a single star is material for many a night's work; and he who would take one or two of a fruitful kind, diligently measure them night after night, note their colors and its changes, if there are any, note accurately their variation of brightness, its limits, and its period, would give an indispensable contribution toward a knowledge of what these twinkling orbs are, and how they are developing.

But what are they? We study them at a great disadvantage. They are so far away from us that, to the nearest of them, the huge diameter of the earth's orbit, though one hundred and eighty-five million of miles long, appears no longer than a foot rule at the distance of four and a half miles. Or, to think of it differently, consider how small an angle the hour hand of a watch passes over in one second of time. Now, if an hour hand be supposed to be on the nearest star, and if it be kept pointing to the earth as the latter swings from one side to the other of its immense orbit, the angle which it passes over will be only one-thirtieth as great as that which a terrestrial hour hand traverses in one second of time. So much for the scale of the universe.

Such distances are inconceivable. That we can know anything of the stars so far away, still less that we can penetrate into their mass and tell of the condition of things there, tell even the very substances whose combustion permits us to see them, seems improbable and inconceivable, it would be impossible did there not come to us from them a messenger bearing most conclusive tidings as to the state of being on those orbs when it left them perhaps a century of years ago. This message has been sent to the earth ever since the earth and the stars were; but only within the last twenty years have we been able to find the key to decipher it. But the record is now clear and plain and decisive. These messengers are the rays of light, and this key is the prism. (The lecturer then, with the aid of a projecting lantern and a prism, illustrated the fundamental principles of spectrum analysis and their application to the examination of the heavenly bodies.)

There is then an identity of substance throughout the universe. The elements familiar to us on the earth exist also on the stars; a step which the astronomer of fifty years ago would have deemed impossible has been taken with safety and precision. Astronomy has called in the aid of chemistry, and with it has brought these stellar masses into its laboratories and pulled them to pieces just as if they were not millions of millions of miles away; and now astronomy, in the hands of Norman Lockyer, is repaying to chemistry the debt it has owed by telling it that its so-called elements are not elementary, but multitudinous forms of one common matter, differing arrangements of similar particles, which are as much smaller as our conceptions can grasp as astronomical distances are greater.

We have spoken of the various colors of the stars. By the aid of a familiar illustration let us see if any meaning attaches to this variety. If we heat a piece of metal it first becomes red hot, then white hot, and, when acted on by the intense energy of the electric light, the white heat becomes bluish. If we examine with a spectroscope the changes, the red end only of the spectrum would be visible at first; as the heat increased the orange, the yellow, the green, and the blue would consecutively appear, the color of the metal being that formed by the combination of these. When the whole spectrum is full the color is white, and an increase of heat only adds to the extreme violet rays, which give a bluish tinge to the color so well known in our electric lights. If we may apply the same theory to the stars, we would infer that the blue stars, like Vega and Sirius, are intensely heated, that they glow with an energy, and emit a splendor by the side of which our own sun pales, and that the fortunate or unfortunate inhabitants of their dependent worlds are subjected to influences of which we do not know. The yellow stars are like our sun in the second stage of heat and light giving. (For, unlike our piece of metal, the great suns of space are probably going through their changes from hot to cold instead of the reverse.) The red stars are still older and the blood red stars older still, small and inconspicuous, nearly dead, only red hot.

Now, Lockyer considers these four orders as representing four stages of sun life: the vigor of youth, the golden age of manhood, the declining strength of age, and the decrepitude which precedes death; and he attempts to draw from the analysis of the light from these a confirmation of his theory. The spectra of the white stars are conspicuous for the vast increase of the hydrogen lines and the general absence of the others, while in the red stars the hydrogen seems absent altogether. The theory then is (and I mention it merely as a theory against which some facts militate), that hydrogen, the lightest of all substances, is also the simplest, and that, at the great heat of Sirius and Vega, the so-called elements are separated into the fundamental hydrogen, and it alone appears. We do not have free hydrogen on the cold earth; it is in combination with oxygen and other substances in water and elsewhere; and, as the stars cool down and become redder, the hydrogen spectrum disappears, the hydrogen combines with itself or something, and forms the sodium, the iron, and the calcium. Hence, Lockyer tells the chemists that they must cease to call sodium and iron and calcium elements, for up in those laboratories of the sky, where the heat is great, out of all proportion to our oxygen and electric lights, these substances separate into yet more elemental forms of matter, and are, therefore, but varying combinations of the one primitive hydrogen.

The stars older than the red ones are invisible to us; they may still be energetic, just as Jupiter is believed to be giving out light and heat in a small way, but they can send no message to us across the Great Gulf that separates us. One stage more and they are cold and comfortable like the earth, or a mass of frozen volcanoes and extinguished energies like the moon.

There is then one general type of all the stars, an intensely heated and blindingly bright molten mass, surrounded with an atmosphere less hot and bright in which hydrogen plays an important part, but which also contains the vapors of such substances as iron, calcium, sodium, and magnesium. But inside of this type there is endless diversity in heat, in light, in activity, in condensation, in form; diversity such as exist in the members of the human race, in the trees of the same order, the pebbles of the sea shore. He who studies a star studies one of a class, but he can no more be said to know star structure, its origin, its development, its destiny, than he who looks at the working of only one man's mind can be said to be able to fathom the motives, the tendencies, and the aspirations of the human family.

Such being the structure of the stars the next question that arises is, What is the condition of things there? Are their surfaces great Pacific Oceans of molten matter, unruffled by disturbances, and quietly beaming out their grateful light as they seem to us to do? or are they tossed by tempests and torn by internal throes? Is the energy which produces light a quiet phosphorescence of the great mass? Or is it ground out by an intense and boisterous vitality of the elements? The nearest star, our own sun, gives us the answer. In the telescope his surface does not look like a quietly glowing mass. It is all broken up into light and dark patches which are not permanent like those of the moon, but continually changing, sometimes with great velocity. Great hurricanes and cyclones seem to sweep over him. Masses of vapor, tens of thousands of miles high, are seen forced up around the edge of his disk with a velocity per second as great as our stormiest winds show per hour. Caverns so wide that a hundred of our earths could be rolled in abreast, and so profound that when rolled in they would be lost in its depths, often open upon his surface. The vaporous mass is torn by explosions heaving up from below, forming a grand uprush of conflicting currents, which as they condense rain down again liquid boron and calcium. On the spent earth and by the action of an external force the water of its oceans is carried up in clouds. But the same energy that draws up these clouds on the earth forces up on the sun, not water, for that is resolved into its components oxygen and hydrogen, but those vaporous metals which here lie quietly in our solid rocks. And as, when the attractive force of the sun is overcome by the cohesive forces of the liquid, they form in drops and fall upon us, so when the upheaving energy of the solar volcanoes is spent, the colder regions of space condense the vapors and metallic rains return them again to the sun to feed the unquiet solar oceans. The lighter gases, of course, fly the highest, and the beautiful rose-colored flames, formerly seen only in total eclipses, extending in mountainous ridges around the disk, but now, by a happy contrivance of the spectroscope, studied at any time, give the indubitable bright bands of glowing hydrogen. Indeed, they could not be solid mountains, as they move about in cloud like forms, sometimes far overhanging their bases and sometimes even separate from them. The solar surface is irregular in its activity. Like the earth it has its stormy times and its quiet ones. Meteorologists are trying to find a cycle in our weather variations, to prove that our old-fashioned winters and our seasons of rainfall and drought come again at regularly recurring intervals. Whether they succeed or not there is certainly this periodicity in solar activity. By estimating the amount of surface covered by spots through a long period of time, it becomes evident that every eleven and a quarter years there is a maximum of disturbance when all the energies of the sun become most vigorous and effective. This maximum comes during the present year, and an occasional glance at the sun by those who have telescopes will probably pay for the trouble.

In 1859 an English observer was mapping a conspicuous sun-spot, when he was surprised to see a white and intensely bright object like a star form itself in the center of the spot. He examined it carefully to see that it was no optical delusion, noted the exact time, and went to call some one to see it, and when he returned it had vanished. It did not last five minutes. The statement is corroborated by a second observer, who chanced to be watching the sun at the same time. Here must have been a remarkable display of energy to form a star so large and so bright, and cause it to vanish away so quickly. But a curious coincidence rendered it still more remarkable. At the same instant of time, a magnetic storm seemed to pervade the earth. Magnetic needles turned from their fixed positions, and rigidly pointed out new meridians. The telegraphic lines refused to work. Here in Philadelphia the operators received severe shocks. In Boston a flame of fire was seen to follow the pen of the automatic recorder. In Norway the apparatus was set on fire. Brilliant auroras were seen all over the earth, even in equatorial latitudes and in regions so remote from each other as Rome and Cuba. Unusual currents were evidently in motion through the earth. A storm was on the sun, and the earth, and, in all probability, the other planets, throbbed responsively with it. Such a coincidence has not chanced to be frequently observed, but there is no doubt that solar activity and terrestrial activity are coincident, and it may be that the Old Probabilities of the future will found his prognostications of the weather, not on telegraphic reports from our western signal stations, but on the laws which govern the development of solar activity. But the coincidence does not rest on isolated instances. The variations of magnetic disturbance and of the sun spot frequency, have been compared through a long period of years, and the agreement is too striking to be accidental.

Such is the sun—a seething caldron of indescribable vitality, a quaking and boiling ocean, now quiescent, now torn by throes of exploding gas, now wrapped in flames of burning hydrogen, the scene of intense chemical activities which combine and loosen and change the state and volume of its constituents continually. Analogy would go to prove the stars the same after their sameness in composition and constitution had once been demonstrated by the spectroscope. But a few additional proofs of the existence of cyclones and sudden disturbances on the stars have been given of late years.

In 1572 Tycho Brahe noticed a star as bright as Jupiter where he was certain it did not exist a half hour before. It grew in brightness till it could be seen at midday, then gradually disappeared till it vanished altogether.

In the star Eta Argus, in the Southern Hemisphere, we have an example of another class. Every seventy years it becomes the brightest star of the heavens. At intervening times it sinks to the sixth magnitude. But in its brightness it is fitful. Through twenty-five of the seventy years it fluctuates backward and forward several times from the second to higher than the first magnitude.

In Perseus, now visible nearly overhead, is the star Algol,

* Read before the National Academy of Sciences New York, 1880.

† From a lecture delivered at the Academy of Fine Arts, Philadelphia, February 8, 1881.

the Demon. With undeviating regularity, which can be calculated to a minute every 2·86 days it goes through its changes from magnitude 4 to 2¼, and from 2¼ to 4 again, always remaining in the same stage, the same exact length of time. Any one can follow its changes.

One step more. We have seen that every 11¼ years our sun reaches its position of maximum energy, when the outbursts of light and activity become most manifest.

These four cases are gradations which take us from the sun to the fitful and excessive outbursts of temporary stars. We know that in the sun flaming hydrogen occupies a conspicuous place in the light prominences, and we should also add a substance as yet unknown upon the earth, and to which the name helium has been given. Now, in two temporary stars that have blazed out since spectroscopic times began, the light has been shown to be beyond peradventure due to the combustion of hydrogen and helium. The stars have become enveloped in the flames of burning hydrogen, a fearful combustion, the light of which was seen in great splendor, even to us, and which must have been insupportable on the unfortunate worlds around it, if such there were. The intermediate stages of variability tell the same story, and though we cannot in the stars see any rose-colored prominences, so common and so beautiful on the sun, the evidence is strong that storms and explosions and convulsions exist in the stellar photospheres, and that out of gigantic world throes and convulsions are evolved the gentle beams of light that "make the floor of heaven so thick inlaid with patines of bright gold."

The stars are not fixed, even relatively, to each other, as the ancients supposed. Arcturus has changed his place among his fellows an amount equal to the diameter of the moon's orbit since Ptolemy first mapped him on his chart. Sirius and Aldebaran have also been in rapid motion. Indeed, it is probable that the aspect of the heavens has changed in some parts since the fanciful names of the Lion and Bear and Dog and Fish were given to the star groupings. There is no similarity to a lion in Leo now, but there may have been 2,000 years ago. It seems a simple matter to record a motion across the line of sight, though in reality it requires very delicate measures. But to measure a velocity directly toward us or from us, or to know from an observed sidewise motion whether the star is really moving diagonally, and we see it foreshortened, might at first be deemed impossible; but, by a happy application of the spectroscope, the problem has been solved with surprising accuracy. Suppose a river flowing uniformly, by the side of which two men are standing, the upper one at intervals of one minute of time throws a cork into the stream. These corks will then pass the second person with uniform spaces between them. Now, let the thrower walk up the stream, still casting his corks at intervals of one minute. A longer space will be noticed by the watcher between the corks as they pass him. If the upper man is walking downward, the corks will be closer together. The observer could evidently tell whether his partner were walking up or down, and at what rate, by the space noted between the floating corks. Now, the stars at regular intervals are giving out messenger undulations of ether, which in us produce the sense of light; and we have seen that the difference between red and blue light is due only to rapidity of vibration. Suppose then a star be moving toward us, the waves will come thicker and faster If possible, let it move so that the red waves could reach us as thick as the blue, then no red at all would be seen in the spectrum—only blue and ultra blue rays. The whole spectrum would be shifted to the blue end. Such a great motion as this would not result from a speed of billions of miles a second. The displacement is indeed extremely slight, scarcely perceptible, and were it not for those dark lines which serve as a very accurate graduation, it would not be perceived at all. But they move with the spectrum, and their displacement is measurable.

So much for the method. The results show a great variety of motion. Sirius is receding from us at the rate of about 30 miles per second, or about 1,000,000,000 miles a year. Other stars show an equally rapid approach. Many stars that had previously seemed stationary were now shown to be in rapid motion. But are the results to be relied on? Some test must be applied. The motion of the spots on the surface of the sun shows that orb revolves on its axis once in 25 days. Evidently then one side is coming to us and the other side receding at a velocity easily calculated. The method was applied to this. The side of the sun coming toward us shifted the lines toward the blue, and the other toward the red; and when Prof. Young calculated by this method the rate of solar velocity of rotation, it differed by only 300 yards per second from that deduced from telescopic observations on the spots. Again, Herschel and a half dozen others, working separately, have deduced the result that the whole solar system is moving through space toward the constellation Hercules, so that when you rise tomorrow morning you will be 170,000 miles nearer Hercules than you now are. Though no change appears in the brightness of these stars owing to our approach, yet the new method fully confirms this. In the Hercules spectra, and in that of Argo opposite, the lines are displaced in one case toward the blue, and in the other toward the red.

Hence all is motion among the stars. There is no such thing as quietness of the masses any more than there is quietness of the elements that compose them. In time we shall doubtless know the laws which govern this motion. When a few more thousand years shall have elapsed, and telescopes shall magnify their powers, and spectroscopes shall become really delicate, and a number of new scopes shall read new messages from the undulations of light and electricity which reach us, and new Newtons and Laplaces shall find new laws to govern bodies so distant from each other, then we may, perhaps, know where and how the sidereal universe is trending, and about what center it revolves. Till then we must believe that the beautiful theory, that the brightest of the Pleiades is the great center of the universe, is without any foundation whatsoever. A few facts of interest are to be noted: The Twins will be separated; Castor and Pollux are moving in opposite directions. Of the seven historic stars in Ursa Major, variously called the Wain, the Plow, and the Great Dipper, five are moving together and in strictly parallel lines, and with equal velocities, showing that their union is not merely optical, but that they really belong to a single company governed by common impulses and purposes. Unfortunately, however, one of the pointers will not keep with his fellows, for while they are going away, he is approaching us. Their cross motions are also different; and if the Pointers have really been placed as they are for man's convenience, to tell him where to seek for the north pole, they are now doing their best to defeat the ends of their creation, and are getting out of line at the rate of some millions of miles yearly. When we attempt to consider the magnitude of the system to which they belong we are utterly lost. Not one of them shows a particle of parallax, no change whatever due to our shifting our position through the immense diameter of the earth's orbit. They are, therefore, immensely distant from us, and hence from each other. One of them has a satellite, just visible to the naked eye, close by it, which, according to calculations, revolves in a period of 8,000 years. In what time the whole system would perform its majestic cycle, and where is its distant center of attraction, defy imagination.

The imposing subject which the elder Herschel, the greatest astronomer that ever looked through the tube of a telescope, set before himself, was to obtain a knowledge of the structure and outline of the universe. His idea was that the stars, about uniform as to size, were scattered uniformly through space, and hence that the brightest were the nearest. That a cluster of stars simply indicated that a number chanced to be in the same line of sight; that where a bright star and a faint one were close together it simply indicated that the faint one was the farthest away; that "the Galaxy, that Milky Way which nightly as a circling zone thou see'st powdered with star," only indicated that in that direction we looked through great stretches of worlds, and that there would be the greatest expanse of the stars. Hence he inferred that the whole sidereal universe was flattened and lens-shaped, somewhat irregular, perhaps, its greatest extent being in the plane of the Milky Way. As the Milky Way was divided into two streams through part of its course, he considered the lens to be cloven along one edge and to extend out in two segments. As in this uniformity there would be no place for the nebulæ, thousands of which he discovered about the heavens, he conceived the sublime idea that they were external galaxies similar to ours, but so immensely far away that their individuality was lost in distance, and their united blaze seemed only a uniform haze. The idea was worthy of the author. But he himself saw occasion to modify it later in life, and modern observations have ruthlessly laid it waste in essential particulars. The nebulæ are certainly many of them not "island universes," similar to our Galaxy in structure, and, perhaps, more complicated, scattered through the ocean of space, but what they seem to be, masses of gaseous light. The bright stars with faint companions are not all simply chance arrangements in the same line of sight, but physically connected systems that have been measured and weighed, and the time and direction of their revolution made known. The nebulæ are so associated with certain stars that no explanation that one is seen projected on the back ground of the other is admissible. The heavenly host is not scattered through space on any principle of uniformity. The brightest stars are not the nearest. There are gradations of color, size, and brightness. Herschel's idea must be abandoned in many essential particulars. Instead of a cloven disk, modern astronomers look with more favor on a cloven ring with its interior less closely packed with stars, with our sun one of a system of several hundred orbs, situated part way from the circumference to the center—our immediate system, though so widely scattered, appearing as a cluster or haze to the eyes of some other world.

A tourist through our universe would then find a wonderful diversity. Sometimes he would meet with a bright and lonely sun like Arcturus and Vega. Sometimes two of them associated together in harmonious union. Sometimes a great cluster, among whose brilliant orbs he might wander, if he were not lost in its complexity. Sometimes he would find masses of star mist, light-giving in itself, and, if not whirled around by its revolving mass, he might reach its central nucleus and study a sun partly made. Sometimes he would get among groups of such cloud-like forms, and see his heavens filled with their fantastic involutions. As he journeyed away the sun would grow small and feeble, until it and Alpha Centauri, and 61 Cygni and their associated orbs would be but a bright cluster in the one field of view. Farther still among the seething suns, through the wave-tossed ether, past worlds traveling with lightning speed, he comes to a point where our sun may no more be seen; new suns are scattered profusely about; the celestial space is alive with their impulses, but the heat and light he is used to he no more feels and sees. Then he knows the insignificance of the little system he lives on, that the sun is as nothing, and the earth still less in the unfathomable universe.

It would be difficult to place a limit to the power of the imagination. Yet the complexity and magnitude of the universe are utterly beyond the power even of the most fertile. We may speak of them, but we cannot conceive of them, and they suggest ideas which are reasonable and probable, but among which the mind is utterly lost.

Let us suppose for a moment that we stand on the sun and look abroad on the system of worlds that is ruled by it. It is indeed a complex and beautiful system. The great planets on their trackless orbits swing around us with undeviating accuracy, while now on this side and now on that their little moons give a divided but harmonious allegiance to them and the sun. With an irregular but orderly motion, comets whisk their fiery tails about us and rush off into unexplored infinity. The spaces between are filled with millions of meteoric bodies, which clash with each other and rain upon us. The ether in which all this motion is going on, and which is so light that gross matter parts it without ripple or stoppage, is swayed and toesed with inextricable undulations of light and electricity. Gravitation with iron bands holds all together, reaching out with a force which cannot be gainsaid, to every corner of the system. Underneath our feet the sun with desperate energy and terrible labor is working out all that is needed to support life on the worlds that it holds to itself. Ay, much more than is needed; for vast as is the energy that it supplies us, two billion times as much goes off into space wasted, it seems to us. Can we conceive the picture we have drawn? Indeed we cannot. Anything we have in our imagination even is feeble by the side of the true painting of the solar system. It is belittling to it. It is only a miniature that we think of, and that unfaithful and inaccurate.

But take one step more. Look at the 6,000 stars we see with the eye, at the 20,000,000 we see with the telescope. It is fact, and not conjecture, that they are bodies which have size and weight, for the double stars move in orbits that are calculated in advance on the supposition that they have weight. It is fact, and not conjecture, that they are fiery hot masses which send out their light to us through dense metallic atmospheres, laden with the vapors of the substances that constitute the solid rocks of our humble little earth. It is fact, and not conjecture, that many of them at least are rushing through space with a speed compared with which the earth's velocity is slight. If we cannot embrace in imagination the puny dimensions of our solar system, what can even the most imperial geniuses do with the facts which these conjectures inevitably suggest? If these orbs are moving, why and whither? Is gravitation lost in these immense stretches, and does some other force come into play, just as cohesion dies away when surfaces are separated a certain distance? If not, around what central point, and what is the direction of the impulse that sweeps along in majestic procession the five brilliants of the Ursa Major, that carries a whole battalion of 70 or 80 orbs in Gemini and Cancer toward the Milky Way, that secures that unanimity of motion so conspicuous among the Pleiades and Hyades? Does every star have the brave muster of retainers that bewildered us as we gazed from the sun, and is every world so unspeakably full of life and beauty as is ours? Do the terrestrial auroras flash coincident with the stellar storms? Do the comets that visit us tell any tales to the astronomers there? Do they carry the seeds of our life to their barren wastes? What are the outlines of the universe, and how is it packed? What mean these little clusters, and how are the stars bound together? Are the nebulæ but different stages of sidereal growth, and do we look on youth, strength, and decay of star life in the variety of the heavens? Are catastrophes of burning worlds of frequent occurrence, and may we expect the sun to be consumed with the fervent heat of burning hydrogen? Are unexpected activities often in play, and are laws of which we have no conception moulding and directing in a marvelous way the fiery surfaces of the starry host? Are there gigantic cycles of heavenly vitality? Is destruction but a forerunner of renovation—a burned world the beginning of a youthful system, the death of the old life the dawn of new? What are different steps of the development which God sustains under the laws which God created?

These questions are not science, but they are its legitimate outgrowth, and it is not presumptuous to ask them, or to believe they will some day be answered. They will be solved, if solved at all, not by popular astronomies, by lectures, and by declamations, but by quiet plodders in most unpoetical work; by students who night after night map and measure, and day after day add and multiply, and by men who can wield the resources of the higher mathematics, and apply it to some of the easier problems of the stars.

THE EARLY PRACTICE OF MEDICINE BY WOMEN.

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IN attempting to sketch the history of the entrance of women into the medical profession we find the earlier periods obscured by a meagerness of material and a lack of sequence which our superficial researches have failed to supplement.

Isolated cases of gifted women attaining notable surgical skill and successfully pursuing the divine art of healing are recorded at various epochs in the history of the intellectual development of women, but they occur at long intervals of time and in widely scattered chronicles. In the following pages we have not undertaken to present an exhaustive history or catalogue of female practitioners of medicine; we have simply collected a few scattered notices, and moulded them into an outline to be hereafter filled up by a more competent hand.

These notices refer to the earlier history only, and by earlier history we mean the period prior to the establishment of medical schools for women, and to the present movement for their higher education. From the earliest times women have successfully grappled with a most difficult branch of medical science, gynecology, but long-existing and deep-seated prejudices prevented an extension of their practice, and, save in exceptional cases, they were forbidden both the acquirement of accurate and systematic knowledge and the exercise of their chosen vocation. So long as the practice of medicine formed a part of the priestly functions, as in ancient Egypt, the crafty guardians of superstition sedulously concealed their superior knowledge from an ignorant and credulous people, and especially from women. Yet the story of the birth of Moses shows that female gynecologists were not unknown to the Egyptians.

At a later period the Greeks thought to add dignity to the practice of medicine by forbidding it to slaves and (forsooth!) to women. During the Middle Ages, when every branch of science was more or less dishonored by degrading superstitions, we find women, as well as men, yielding to their influence and exercising the double calling of sorceress and healer of the sick; nor has the intelligence of the common people even in the nineteenth century reached such a height as to render the business of medical clairvoyant nugatory and profitless.

The invention of medicine was almost universally attributed by the ancients to the gods, and it is a curious fact that in both Egyptian and Grecian mythology we find female deities occupying important relations to the healing art. To the Egyptian deity Isis, the wife and sister of Osiris, peculiar medical skill was attributed, and a multitude of diseases were regarded as the effects of her anger. According to tradition she had given unequivocal proof of her power by the restoration of her son Orus to life. She was the reputed discoverer also of several remedies, and even as late as Galen the materia medica contained several compounds which bore her name: thus, in the symbolical language of the Egyptian priestly physicians, the vervain was called the "tears of Isis."

According to the annals of Grecian mythology, Hygeia, daughter of Esculapius, the God of Medicine, was worshiped in the temples of Argos as the Goddess of Health. In art, Hygeia is represented as a virgin wearing an expression of benevolence and kindness, and holding in one hand a serpent which is feeding from a cup in the other. She was regarded as the goddess both of physical and mental health, thereby personifying the aphorism "Mens sana in corpore sano." The Greeks also ascribed medical power to Juno, who, under the name of Lucina, was held to preside over the birth of children; and to Ocyroe, daughter of the Centaur Cheiron, who was renowned for his skill in surgery and medicine. The sorceresses Medea and Circe were said to make use of herbs in their enchantments and for the purpose of counteracting the effects of poisons. These and similar fables probably preserve in allegoric form facts connected with the practice of medicine by women in the remotest antiquity. The writings of Homer have been examined to ascertain his testimony, but with the exception of slight reference to woman's part in nursing wounded warriors, he contributes nothing to the subject under consideration.

The learned among the Celts, the Druids, were at the same time judges, legislators, priests, and physicians. By persuading the people that they maintained intimate relations with the gods, they succeeded in imposing their authority on the ignorant masses. "Their wives, who were called *Alraunes*, exercised the calling of sorceresses, causing considerable evil by their witchcraft, but caring for warriors wounded in battle. They gathered those plants to which they attributed magic virtues, and they unraveled dreams." (Dunglison.)

The first female practitioner who received a medical edu-

cation appears to be Agnodice, a young Athenian woman who lived about 300 B.C. To satisfy her desire for knowledge she disguised herself in male attire, and, braving the fatal results of detection, dared to attend the schools of medicine forbidden to her sex. Among her instructors was numbered Herophilus, the greatest anatomist of antiquity, and the first who dissected human subjects. After completing her studies, Agnodice preserved her disguise and practiced her chosen calling in the Grecian capital with great success, giving particular attention to the diseases of her own sex. The physicians of Athens, becoming jealous of Agnodice's great reputation and lucrative practice, summoned her before the Areopagus, and accused her of abusing her trusts in dealing with female patients. To establish her innocence Agnodice disclosed her sex, and her persecutors then accused her of violating the law prohibiting women and slaves from studying medicine, but the wives of the most influential Athenians arose in her defense, and eventually obtained a revocation of the law.

The laws and customs of the Romans, as well as of the Greeks, were antagonistic to the entrance of women into the medical profession, yet Galen, Pliny, and others have preserved the names of a few distinguished in the art of healing: Phænarete, the mother of Socrates, Olympia of Thebes, Salpe, Sotira, Elephantis, Favilla, Aspasia, and Cleopatra. Of these, details are generally wanting. Scribonius Largus writes of an "honest matron" who cured several epileptic patients by an absurd remedy, and mentions having purchased of a woman a prescription for the cure of colic, the composition of which she had learned in Africa. Why Aspasia appears in this connection is not perfectly clear; the talented wife of Pericles, renowned as "a model of female loveliness," was doubtless too involved in affairs of state to undertake the absorbing cares of the medical profession. Cleopatra, the accomplished and luxurious Queen of Egypt, of whom so many marvels are related, is named among those women possessed of medical skill; she is reported to have compounded cosmetics, and to have written on the art of preserving beauty; but this statement is probably no more worthy of credence than that of the infatuated alchemists of the Middle Ages, who would persuade us that Cleopatra was the fortunate possessor of the philosopher's stone and of the universal solvent. In proof of the former statement they point to her personal attractions, unchanged by increasing years, and to her immense wealth; in proof of the latter they rely with confidence on the well-known fable of the solution of the costly pearl at the extravagant banquet to Marc Antony.

In a Roman lady named Fabiola we find an early predecessor of Florence Nightingale. She was of the illustrious house of Fabius, and was celebrated in the fourth century for piety and charity. She is to be held in grateful remembrance as the founder of hospitals in Italy, and she is said to have personally nursed the sick at Ostia. The establishment of hospitals is commonly credited to the Emperor Julian, 362 A.D., with whom Fabiola was contemporary; perhaps she took an active part in the humane movement, and held a position analogous to that of lady manager in modern times.*

Half a century later lived a woman justly distinguished for combining in one person a high degree of female loveliness, womanly virtue, and intellectual strength; though not occupied with the art of healing, we cannot pass in silence the accomplished Hypatia. Born at Alexandria in the latter part of the fourth century, the daughter of Theon, an eminent mathematician and philosopher, she soon excelled her father in these branches of learning. After profiting by profound studies under celebrated masters at Athens and Alexandria, she publicly taught philosophy at both these centers of culture. Gibbon writes of her: "In the bloom of beauty and in the maturity of wisdom, the modest maid refused her lovers and instructed her disciples." On Hypatia's inhuman murder, at the instigation of the jealous Cyril and his fanatical followers, it is not here necessary to dwell.

The practice of medicine by women obtained to some extent during the Middle Ages. Under the influence of Mohammedan rule women were placed in excessive isolation, and it is not surprising to find under these circumstances that certain women were skilled in attending to the requirements of their own sex. Thus Albucasis, of Cordova, one of the most skillful surgeons of the twelfth century, secured the services of properly instructed women for assistance in operations on females in which considerations of delicacy intervened. Avicenna, also writing of remedies for diseases of the eyes, mentions a collyrium compounded by a woman well versed in medical science. On the whole, however, the number of women instructed in medicine among the Arabs was very small, owing possibly to the inferiority to which women were condemned by Eastern usages.

In Christian countries the nuns as well as the priests attended to the healing of the sick as an act of charity and piety. Abélard, in the twelfth century, permitted the practice of surgery to those of the convent of the Paraclete, over which Héloïse presided. The most celebrated of the learned nuns was Hildegarde (A. D. 1098 to 1180), abbess of the convent of Rupert-berg, near Bingen on the Rhine. She compiled a sort of Materia Medica, which comprises a variety of superstitious remedies. Radegonde, of France, the founder of a convent at Poitiers (died 587), the pious ascetic Elizabeth of Hungary (died 1231), Hedwigia, wife of Henry the Bearded, and other women who devoted themselves to the care of the sick, may be properly regarded as praiseworthy exemplars of Christian benevolence rather than educated practitioners of medicine.

In the famous school of medicine established at Salernum by Benedictine monks, in the eleventh century, we find women taking an important part. Ordericus Vitalis, in his "Ecclesiastical History" (written about 1130), relates that an abbot eminent in natural sciences, and especially distinguished in medicine, visited Salernum in the year 1059 for the purpose of discussing medical topics, and found no one erudite enough to reply to his propositions save a certain woman of great learning. This woman he does not name, but she is supposed to be the same as Trotula of Ruggiero, whose reputation at that period was world-wide. At Salernum women were engaged in the preparation of drugs and cosmetics, and in the practice of medicine among persons of both sexes; such were Abella, author of two medical poems; Costanza Calenda, the talented and beautiful daughter of a skillful physician, under whose instructions she attained to a doctor's degree; Mercuriade, author of several treatises; Rebecca Guarna, Adelmota Maltraversa, and Marguerite of Naples, who obtained royal authority for practicing the medical art.—(Beaugrand, in "Dict. Encyc. Sci. Médicales.")

* Celsus, who wrote in the reign of Augustus (A.D. 1), mentions large hospitals where patients were treated with specific medicines. (Milligan's Ed., p. 14.) Seneca also refers to them as "valetudinaria."

The ancient and honorable universities of Italy were, we believe, the first to recognize the capacity of women to give instruction of a high character. The University of Bologna, founded in 1116, was attended in the year 1250 by ten thousand students, engaged in the study of jurisprudence, of philosophy, and of medicine. "Here was first taught the anatomy of the human frame, the mysteries of galvanic electricity, and later the circulation of the blood." Here, too, were the earliest successful experiments in admitting women to occupy professorial chairs, for a long line of female professors taught in many departments of learning.*

As early as the thirteenth century two women were numbered among the eminent professors of the University of Bologna—Accorsa Accorso and Bettisia Gozzadini; the former held the chair of philosophy, the latter that of jurisprudence. In the fourteenth century the lovely and learned Novella d'Andrea, daughter of a distinguished lawyer, often took her father's place in the professorial chair, and instructed his students in law. Of Novella it is reported that she was so beautiful that she lectured behind a curtain, "lest if her charms were seen, the students should let their young eyes wander over her exquisite features and quite forget their jurisprudence." The rival University of Padua, founded in 1228, had also its female representatives. Of these the most distinguished was Elena Lucrezia Cornaro. This interesting woman was born at Venice, June 5, 1646, and at a very early age exhibited an extraordinary capacity for acquiring languages. She was familiar with French, Spanish, Latin, Greek, and Hebrew, besides her native Italian, and had some acquaintance with Arabic. While endowed by nature with poetical and musical talents, she possessed at the same time great perseverance and capacity for serious studies, and discoursed eloquently on abstruse topics in philosophy, mathematics, astronomy, and theology. At the age of 32 the University of Padua conferred upon her the degree of Doctor of Philosophy. Cornaro seems never to have held any public position, being naturally of a retiring disposition, and moreover exceedingly devoted to the order of St. Benedict. After acquiring a European reputation she died at the comparatively early age of 38, 1684.

The beginning of the following century witnessed the birth of one of the most gifted women the world has ever seen. Laura Caterina Bassi was born at Bologna, October 31, 1711. She was the daughter of a distinguished lawyer and *littérateur*, and at a tender age manifested extraordinary precocity, being able while still a child to translate fluently most difficult Latin and Greek. Encouraged by her father, she pursued her studies under the guidance of eminent masters; she learned physiology and medicine with the erudite physician Gaetano Tacconi, mathematics with Manfredi, and natural philosophy with the disciples of Gassendi, and she astonished these profound philosophers by her talents. Laura Bassi studied for the pure love of knowledge, and had no ambition to seek public honors, but to gratify the pardonable pride of a father as well as the earnest desire of her instructors, she consented to support a philosophical thesis before a learned audience of professors. This event took place on the 17th of April, 1732, before she had reached the age of 21 years. The occasion was made one of festivity by the whole city, who turned out to do her honor; the assemblage was presided over by two cardinals—Lambertini, afterwards Pope Benedict XIV., and Grimaldi. According to custom her thesis was opposed by seven learned men; to these she replied in elegant Latin with great success and amid the applause of the distinguished audience. A month later the degree of doctor was conferred upon her, and she was honored by a position in the faculty of philosophy. The senate subsequently bestowed upon her the chair of physics, and commemorated the event by striking a medal which bore her own portrait. She held the professorship twenty-eight years with marked success, paying particular attention to mathematics and physics, also to *belles lettres*. Several academies of learning elected her to membership. In 1738 she was married to J. J. Veratti, a physician, and became in the course of time the mother of twelve children. A learned French *littérateur* who visited Bologna in her day thus describes her appearance: "Laura Bassi has a countenance slightly marked with small-pox, but of a sweet and modest expression; her black eyes are sparkling, yet tranquil, and she is serious and composed in demeanor without affectation or vanity. Her memory is tenacious, her judgment sound, and her imagination active." She died in the year 1778, at the age of 67.

Laura Bassi does not seem to have pursued medical studies, and certainly never engaged in practice; but any account of the gifted women of Bologna who labored in this direction would be incomplete without a brief notice of Madame Veratti.

Contemporary with this interesting woman lived another, less gifted but scarcely less renowned. Anna Morandi was born at Bologna five years later than Laura Bassi, and died four years earlier. She became the wife of Giovanni Manzolini, a poor, hard-working maker of anatomical models. Manzolini was an expert painter and modeler in wax, and was employed by one Lelli to construct a series of anatomical models for the use of the professors in the Institute of Bologna. Anna not only aided her husband, but soon surpassed him in skill, and particularly in that scientific knowledge upon which the success of their joint labors so largely depended. About this time Giovanni Antonio Galli, a skillful surgeon and professor of gynecology, opened a school of obstetrics in his house, and, encouraged by him, Anna began to lecture on anatomy to private classes. In these lectures she not only imparted with peculiar talent the knowledge derived from her husband, but she also communicated many discoveries made by herself. So great was her skill in all dissections requiring delicacy of touch and minuteness of detail, and so clearly did she demonstrate, both theoretically and practically, the wonderful structure of the human body, that she rapidly acquired a European reputation, and her lecture-room was frequented by students of all countries.

In 1755 Anna Manzolini became a widow, and was left with very slender means of support, but her good qualities raised up friends who secured for her a comfortable subsistence. Though she received tempting offers from other Italian universities, and even from England and Russia, she preferred to remain in her native city, Bologna. Not long after her husband's death she was appointed to the chair of Anatomy in the Bologna Institute.

Anna Morandi-Manzolini enjoys the distinction of having been the first "to reproduce in wax such minute portions of the human body as the capillary vessels and the nerves." Her collection of anatomical models, still to be seen at the Institute of Science, bears silent testimony to her remarkable skill and accurate knowledge. "Her lectures were delivered in the fragrant cedar hall, which is one of the modern sights of Bologna, and in which Lelli's anatomical wooden figures supporting the canopy over the professorial chair attract general admiration." In the anatomical galleries of the university is to be seen her portrait in wax, modeled by herself at the request of many admiring friends. Anna Manzolini closed a laborious and honored life in 1774, at the age of 58 years.

The city of Bologna, in the middle of the eighteenth century, saw three gifted women simultaneously occupying seats in the faculty of its ancient university. Besides Laura Bassi and Anna Morandi-Manzolini, of whom we have briefly spoken, Maria Gaetano Agnesi was equally distinguished.

Maria Agnesi was born at Milan, March 16, 1718. At an early age she manifested a remarkable facility for acquiring languages, and when only 20 years old was able to discourse in French, Spanish, German, Greek, and Hebrew, besides her mother-tongue. She displayed marked ability also in philosophy and mathematics, and while still young sustained one hundred and ninety-one theses, which were afterward printed under the title "Propositiones Philosophicæ." In 1748 Agnesi published a treatise on algebra, including the differential and integral calculus, in which she displayed wonderful judgment and erudition. This work ("Institutzioni Analitichi") was afterwards translated by Colson, the Lucasian Professor of Mathematics at Cambridge, and was used by the students of that university. In 1750 her father, who was Professor of Mathematics at the University of Bologna, fell sick, and she obtained permission of the good Pope Benedictus XIV. to occupy her father's chair. In person Agnesi is said to have been beautiful, modest, and of pleasing manners. Her severe studies overtaxed her delicate frame, and shortly after she renounced the world and took refuge among the Blue Nuns at Bologna. In this nunnery she lived several years a devotee and an invalid; she died in 1799.

While Laura Bassi taught physics, Anna Morandi-Manzolini anatomy, and Maria Agnesi mathematics, in the Bolognese University, we might naturally expect the gentler sex to avail themselves of the opportunity of studying under their sisters' instructions. And such, in fact, was the case; the names of some of these students are recorded by the historian, many of whom received the degrees of Doctor of Philosophy and Doctor of Medicine. In 1799 Doctor Maria delle Donne appears as Professor of Medicine and Obstetrics; Clotilda Tambroni was Professor of the Greek Language and Literature, from 1793 to 1808. To these names should be added those of Novella Calderini, Maddalena Buonsignori, Dorotea Bocchi (who was both doctor and professor), Christina Roccati, Ph.D., Zaffira Ferretti, M.D., Maria Sega, M.D., and numerous graduates of Padua, Pavia, Ferrara, and other Italian universities.

Leaving the Italian peninsula, which was so productive of remarkable personages, we will briefly examine the position of women practitioners of medicine in other parts of Europe.

Beaugrand states that the most ancient document extant relative to the organization of surgery in France forbids the practice of surgeons and of *female* surgeons who have failed to pass a satisfactory examination before the proper authorities. This paper bears the date 1311. References to female surgeons appear again in an edict of King John in 1352. From these documents it appears that women exercised the function of surgeon under legal authority. At a somewhat later period we find the calling of physician followed by women in Spain, Germany, and England.

In Spain, the Universities of Cordova, Salamanca, and Alcala honored many women with doctors' degrees. We note also the appearance at Madrid, in 1587, of a learned medical work entitled "Nueva Filosofia de la Naturaleza del Hombre," and published over the name Olivia del Sabuco. Of this person, however, nothing whatever is certainly known, and it has been conjectured that the name Olivia was a pseudonym assumed by some eminent physician.

In Germany many women cultivated medical science: Barbara Weintrauben was an author of no great merit; the Duchess Eleanor of Troppau, Catharina Tissheim, Helena Aldegunde, and Frau Erxleben are deserving passing notice. The last mentioned was one of the most successful female practitioners of the last century. Her maiden name was Dorothea Leporin, but she is best known as Frau Erxleben. Fräulein Leporin pursued her medical studies at the University of Halle, and obtained a diploma in 1734. She settled in the little town of Quedlinburg, at the foot of the Hartz Mountains, became the wife of the rector of the Church of St. Nicholas in the same place, industriously practiced her profession, and became eminent for her skill and learning. Her son, J. C. P. Erxleben, inherited from his mother a love of scientific pursuits, and became a distinguished naturalist and professor in the University of Göttingen.

In England, Anna Wolley and Elizabeth of Kent were occupied with the preparation of drugs as early as the seventeenth century, and both published works on medical subjects.

In this hasty and superficial sketch of the history of the early practice of medicine by women we would not be true to the facts if we omitted mention of certain ignorant and vulgar women who assumed medical knowledge and medical skill to impose upon a too credulous public. That avaricious women, fond of notoriety and careless of their reputation, should imitate the methods adopted in every age by unprincipled men, is not surprising, though it may be mortifying. To this class belonged Louise Bourgeois, nurse to Marie de' Medici, the Queen of Henry VI. of France; though an ignorant charlatan, she acquired extraordinary influence over her royal patroness, and her career abounds in curious eventful episodes. She was the author of several medical treatises on the diseases of women, one of which was published at Paris in 1617.

A century later another female practitioner flourished, of whom women have no reason to be proud. In the year 1738 Mrs. Joanna Stephens proclaimed in London that she had discovered a sovereign remedy for a painful disease. Notwithstanding her gross ignorance and vulgar demeanor she secured a large circle of patients from among the upper and wealthy classes, and, after enriching herself by enormous fees drawn from their credulity, she proposed to make her medical discovery public in consideration of the modest sum of twenty-five thousand dollars. A subscription was started for this purpose and enthusiastically taken up; the clergy, lords, and ladies, with an inexplicable infatuation, hastened to add their names to the list of subscribers. Failing, however, to raise so large a sum of money, Mrs. Stephens's friends obtained a grant of the desired amount from parliament. The certificate testifying to the "utility, efficacy,

* According to Madame Villari, whose papers on the "Learned Women of Bologna" furnish us with many of the succeeding data, there is to the present day no law preventing women from graduating at Italian universities or taking professorial positions.

and dissolving power of the medicines," bears the date March 5, 1739, and is signed by twenty justices. These dearly purchased remedies were three in number, "a powder, a decoction, and pills." The powder consisted of calcined egg-shells and snails; the decoction was a disgusting mixture of herbs, soap, and honey, boiled in water; and the pills were made of "calcined wild-carrot seeds, burdock seeds, ashen keys, hips, and haws—all burned to a blackness—soap, and honey."

Contemporary with Mrs. Stephens lived another impostor, Mrs. Mapp, sometimes known as "Crazy Sally of Epsom," and described as an "enormously fat, ugly creature, accustomed to frequent country fairs, about which she loved to reel, screaming, abusive, and in a state of beastly intoxication." This attractive lady was by profession a bone-setter, and was patronized by patients of rank and wealth, who sought her charily bestowed favors with ill-disguised contempt of her person. The town authorities of Epsom greatly esteemed Mrs. Mapp, or perhaps we should say highly valued the benefit the town derived from the influx of wealthy patients, and they offered her the sum of five hundred dollars per annum if she would continue to reside in the town.

The first half of this century has witnessed the career of a few women eminent in the art of healing. In France Madame La Chapelle had an extensive gynecological practice, and Madame Boivin attained to such distinction that she was honored with the degree of Doctor of Medicine by the University of Marburg. In Germany Charlotte Heidenreich and Frau Heiland, her stepmother, were similarly honored with doctors' diplomas.

It is the glory of America that she is distinguished above all countries not only as the cradle of liberty, but also as the foster-mother of the intellectual advancement of women. Yet this has not always been the case; in the early chronicles of the colonists (themselves refugees from persecution), we find, strangely enough, many laws of an exacting and repressive character, some of which were aimed directly at the ambition and zeal of women. In the famous Blue Laws of Connecticut the following curious entry occurs under the date of March, 1638: "Jane Hawkins, the wife of Richard Hawkins, had liberty till the beginning of the third month called May, and the magistrates (if shee did not depart before) to dispose of her; and in the mean time shee is not to meddle in surgery or phisick, drinks, plaisters, or oyles, nor to question matters of religion except with the Elders for satisfaction." ("True Blue Laws of Connecticut," by J. H. Trumbull, 1876.)

A hundred and forty years later we find marked progress in liberality in the State of Connecticut. As early as 1773, in the town of Torrington, Litchfield County, two women were greatly honored and much sought for on account of their remarkable skill as accoucheuses. The first of these, Mrs. Jacob Johnson, to quote the historian of Torrington (Rev. Samuel Orcutt), was as thoroughly known and trusted in her profession as any physician that was ever in the town. "She rode on horseback, keeping a horse for the special purpose, and traveling night and day, far and near," to meet her engagements. "She kept an account of the number of cases she had, and the success of the patients, and the newcomers, and of these last there is at least one living in the town. In the midst of her usefulness she was removed by death, and it became a great inquiry, 'Who will take the place of Granny Johnson?'" This question was answered more successfully than anticipated in the person of Mrs. Huldah Beach, daughter of Aaron Loomis, jun. Mrs. Beach became as celebrated in her calling as Granny Johnson, and continued to attend to her professional duties until an advanced age. She was a woman of remarkably fine personal appearance and decided dignity of carriage, yet marked kindliness of manner. Her intellectual strength and ability were perceptible to every one, and she in consequence commanded great respect in all classes of society, and won the confidence of the people so that but few calls were made on any other physician in her specialty, on the western side of the town. She also rode as far as Winchester, Goshen, and Litchfield.

Dr. Orcutt, whose "History of Torrington" has furnished us with these particulars, remarks in this connection: "Many have imagined that, in the practice of medicine by women, a new era has arrived, but in this there is only a 'retoration of the lost arts.'"

Our allotted task is completed, yet we cannot close this address without a brief survey of the present period, in which the facilities afforded women in all branches of learning contrast strongly with the impediments and obstacles formerly well nigh insurmountable.

Women desirous of acquiring medical knowledge are no longer obliged to disguise themselves in male attire like Agnodice the Athenian, nor are practitioners liable to suffer the penalties of the law for their works of benevolence and charity. In 1880, the young woman with aspirations for intellectual culture finds open to her such excellent training schools as Holyoke, Wells, and Rutgers—such noble institutions as Vassar, Smith, and Wellesley. Does she not shrink from contact with her brothers, she may gain entrance into many universities, either expressly founded in a liberal spirit—as Oberlin, Cornell, and Ann Arbor—or which have yielded to the steady pressure of public opinion, and now open their doors more or less widely to the gentler sex. To enumerate the latter would be tedious and unprofitable; suffice it to say that even venerable and aristocratic Harvard has lately joined the number, and our own Columbia, should her president's views prevail, will not be slow to follow.

The young woman who seeks intellectual training of a more technical character, with a view to adopting a professional career, will find many avenues opening up with constantly increasing privileges and facilities. The student in art, thanks to the philanthropy of our venerable citizen, Peter Cooper, can, without incurring expense, acquire a knowledge of designing or of wood engraving which will hardly fail to secure for her a competence. The student in biology will receive her share of attention at a summer school of science on our Atlantic seaboard, or held in connection with some enterprising institution of learning. The student in pharmacy and chemistry can conduct her researches on an equality with men, or, if she prefer, in laboratories controlled and officered in large part by women themselves.

The student in medicine now gains access to medical colleges in nearly every State in the Union, and the legitimacy of her pursuit as well as her ability to grapple with it gains increasing advocates. "She is no longer regarded as too good and too stupid to study medicine." The candidate for medical honors also finds in Boston, Philadelphia, New York, and Chicago, well-appointed schools of medicine especially adapted to her needs, with corps of trained and sympathizing instructors ready to lend a helping hand.

Looking across the Atlantic, we find countries so lately intolerant of the intellectual advancement of women at last yielding, not always gracefully, to the inevitable. The little republic of Switzerland, and the mighty empire of Russia, have for many years manifested practical sympathy with the cause; and now, slowly yet surely, conservative England begins to recognize the fact that the Anglo-Saxon race, with its boasted love of liberty, has been neglectful of its duty to womankind.

To trace any more fully the history of the recent period does not fall within the province of our address; we look to the pioneers of this movement who are still with us for an exhaustive and authentic record such as participators and eye-witnesses alone can supply.—*Journal of Science.*

ON THE BENEFICENT AND TOXICAL EFFECTS OF THE VARIOUS SPECIES OF RHUS.*

By T. J. W. BURGESS, M.B.

THE paper that I have prepared for your consideration deals with a class of plants which, whether considered with reference to their beneficent or toxic effects on the human race, should be known to every practitioner—I refer to the various species of rhus.

The most noteworthy example of this genus in our own country, and the one to which the greater part of my remarks will apply, is commonly called poison ivy. So far as my own knowledge extends, but little is known of this plant to the profession at large, except through cases of poisoning by it presented for treatment. Now, when we consider how common it is, and the number of persons liable to exposure to its noxious influence—the laborer engaged in railway work and in clearing bush-land, the farmer working about his fences, one of its favorite lurking places, and the child so often employed in gathering the wild flowers with which our woods abound—I cannot impress on you too strongly the necessity for a thorough knowledge of the various species, their appearance, and that of the plants with which they are most likely to be confounded, and their physiological effects, with the prevention and cure of these. Some of the varieties being used for domestic purposes and others in the practice of medicine, I will also draw your attention to their uses in the arts and their pathological effects, with the classes of cases in which they have been found most beneficial when employed as medicines.

The only representative of the large order, *Anacardiaceæ*, the Cashew family, in northern North America, is this genus rhus, a name derived from the Greek verb *reo*, "to flow," so called because it was thought to be useful in stopping hemorrhages. And, truth to tell, the name was not inaptly applied by our forefathers, all the varieties being possessed of more or less astringent properties, some of them in a very marked degree. The genus, to the non-botanical commonly known as sumac or shumac, is composed of trees or shrubs, having a resinous or milky acrid juice; alternate leaves; small, regular, greenish-white or yellowish flowers; and a fruit forming a sort of dry dupe.

No less than fourteen varieties of rhus are or have been used in the arts and sciences (the term including medicine), and these I shall, for convenience of description, divide into two classes, native and foreign, dismissing the latter with but a brief mention of their uses.

Of the foreign species there are six:

Rhus cotinus, sometimes cultivated in our gardens for ornamentation, under the names "smoke plant," "purple fringe tree," and, from the curious appearance of its seed vessels, which look like a powdered wig, "periwig tree," is known in commerce as Venice sumac. It is a small tree with purplish-green flowers, supported on hairy peduncles, and is a native of Siberia, Austria, and Northern Italy. It is not used as a medicine or pharmacy, but yields one variety of a wood known in trade as *fustic*, which has been largely employed for producing a yellow dye. A noticeable peculiarity about this species of rhus is that its leaves are simple, like those of the elm and maple, and not compounded, like the horse-chestnut and ash, as is the case with the rest of the genus.

Rhus Coriaria.—Of this, both the leaves and berries have been used as astringents and tonics, and the ground twigs as a dyestuff. It is a native of the Ukraine, in Russia, and has been regarded by the inhabitants of that country, combined with a decoction of genista tinctoria leaves, as a preventive of hydrophobia. It is employed both internally and locally, and the peasantry have great faith in its curative virtues, but extended trials in other parts of Europe have shown it to be useless in this much-dreaded affection.

Rhus succedanea is indigenous in Japan. From its berries is expressed a wax sometimes used in pharmacy, known as Japan wax. It is of medium quality, ranking between bees-wax and the ordinary vegetable tallows.

Rhus vernicifera, varnish or Japan sumac, inhabits India and Japan, where it is highly prized for its yielding, from incisions made in the stem, a gum from which is made one of the best of varnishes.

Rhus metopium is found in the West Indies, chiefly Jamaica, and is said to be one of the sources of "hog-gum" so extensively used by bookbinders in the process of marbling paper. This peculiar, and certainly not euphonious, name, is derived from the fact that hogs, when wounded, are reputed to rub themselves against this tree, so as to cover the wound with this juice, and form a protection against the irritation of insects.

Rhus semi-alata, a native of China and Japan, yields a gall largely used, especially by the Chinese, in dyeing their celebrated yellow silks. It is also highly esteemed by them as an astringent medicine.

Of the native species of rhus there are eight, and, not to afflict you with their scientific distinctions, I will classify them as poisonous and non-poisonous, chiefly confining my botanical descriptions to the poisonous class, it being most important, both in a diagnostic and prophylactic point of view, to be able clearly to distinguish these from certain non-poisonous plants resembling them. The eight species are equally divided, four being innocent and four highly noxious. And first, let me draw your attention to the non-poisonous varieties, meaning by this, non-poisonous by contact with the plant, for, if administered internally, in large doses, even the innoxious ones act as irritants.

Rhus aromatica—fragrant sumac—is a straggling bush with three foliate, hairy leaves; the pale yellow flowers, in clustered spikes like catkins, precede the leaves, which are sweet-scented when crushed. It extends from Lake Superior westward and southward, in dry rocky soil, a variety, the rhus trilobata of Nuttall, chiefly affecting the Rocky Mountains and Sierra Nevadas. This plant has during the last two years, whether justly or not I cannot from my own experience say, obtained a high reputation as an astringent, and is at present being lauded in journals devoted to materia medica. In hæmaturia and chronic cystitis, where the ordinary remedies—ergot, gallic acid, and muriated tincture of iron—have failed, it is said to have been used with the happiest results. In phthisis, though not advanced as at all curative, it has a favorable effect in checking the hemorrhage, night sweats, and diarrhœa, often so exhausting and distressing. Five to twenty drops of the fluid extract may be given every hour in extreme cases of hemorrhage, and lessened as relief is obtained. For the diarrhœa fifteen drops may be given after each stool, while the night sweats are best treated with a dose of ten to twenty drops each night at bedtime. In the diarrhœa of children, where the stools are frequent, the pulse soft and feeble, the skin pale, the eyes sunken, and there is loss of flesh and general sense of lassitude, it is by some regarded as invaluable. Its use is also advocated in menorrhagia, dysentery, and diabetes insipidus, but it is in enuresis (incontinence of urine) that it has gained its highest reputation. Dr. Cooper, of Bellefontaine, Ohio, regards it almost as a specific in this complaint, and in the November, 1879, number of *New Preparations*, records a number of cases cured by its use. From the strong testimony to its value, I would urge upon you, who are much more likely to see cases of this not uncommon affection than one engaged in asylum practice, to give it a fair trial, if you have not already done so. It is given in fifteen-drop doses four times a day, the last being administered just before retiring, till improvement takes place, when only the night dose is given, and continued until the habit is cured. At the same time the patient should strictly adhere to the rules of drinking but little during the evening, and voiding urine just before going to bed. The best form for use is the fluid extract, and a nice formula for its administration is:

℞ Fl. ext. rhus aromatica..... ℥i.
Glycerine..... ℥ss.
Aquæ ad..... ℥iv.
M.—Sig. One drachm four times daily.

Several medical friends, who have been using this drug in various affections, have furnished me with records of cases treated by it, which may be thus tabulated:

Disease.	No. of cases treated.	Result.
Chronic cystitis..	1	Much improved.
Phthisis.....	5	In all, attacks of diarrhœa and night sweats were relieved.
Diarrhœa of children.....	9	Six cured; three died.
Diarrhœa of adults.	2	One cured; in the other the drug seemed to have no effect whatever.
Menorrhagia	5	In all there was a wonderful effect in checking the discharge at the time. In three cases, after use at two menstrual periods, the discharge was normal, and has since, now five months, continued so. The fourth case is improving, but the fifth shows no radical change.
Enuresis	3	Two cured; one improved.

This record speaks strongly in favor of an extended trial of the remedy in the class of cases enumerated, though its greatest benefit would seem to be shown in menorrhagia and enuresis.

Rhus glabra, variously known as sleek, smooth, Pennsylvania and upland sumac, officinal in the United States Pharmacopœia, is found over the greater part of North America, south of the Arctic circle. It is a shrub two to twelve feet high, with straggling branches, covered with smooth, light gray or somewhat reddish bark. The compound leaves, consisting of eleven to thirty-one leaflets, whitened beneath, in autumn change to a beautiful red. Growing along fences, borders of woods, and in rocky fields, its flowers open about July, and the fruit, often eaten by the country people, ripens in early fall. Excrescences produced on the under surface of the leaves have been used as a substitute for the officinal galls obtained from the oak, *Quercus infectoria*. Like galls, these excrescences are due to puncture of the young shoots by a hymenopterous insect to deposit its eggs. This irritates the part, and a tumor arises, the result of morbid growth. The eggs enlarge with this growth, and are converted into larvæ, which feed on the vegetable matter. Finally the larvæ become flies, and escape by eating their way out. For use, these excrescences should be collected when of full size, just before the eggs are hatched. All parts of this plant contain a large amount of gallo-tannic acid, and the bark is often used in tanning. The berries have a sour astringent taste, and owe their acidity to malic acid, which, according to Mr. Cossens, is not contained in the berries themselves, however, but in the pubescence which covers them. An infusion of the fruit has been used as a refrigerant drink in febrile complaints, and as a detergent astringent gargle in common and ulcerated sore throat. It has also been employed with great success in mercurial ptyalism, but for this, an infusion, or still better, a fluid extract of the inner bark of the root, is best adapted.

* Read before the Canada Medical Association, at Ottawa. From the *Canadian Journal of Medical Science.*

The fluid extract also possesses tonic properties, and may be used in doses of one-half to one drachm.

Rhus copallina, dwarf sumac, mountain sumac, or the gum copal tree, is a shrub with running roots, one to seven feet high, inhabiting rocky hills. Its branches are downy, and the petioles between the leaflets are wing-margined. Gum copal, so largely employed in making varnishes, is the product of a number of different trees, one of which, according to some authorities, is the rhus copallina. This plant possesses similar, but less strongly marked, properties to rhus glabra, and may be used as a substitute therefor.

Rhus typhina, staghorn sumac, grows very commonly throughout Canada along railway tracks, and on sterile hillsides. It forms a tree ten to thirty feet high, with orange-colored wood. The branches and stalks are densely, velvety hairy, with serrate leaflets, pale beneath. This, the fourth and last of the innoxious native species, also possesses properties similar to rhus glabra, and may be substituted when that plant cannot be had.

Of the four indigenous species which possess poisonous properties, one is an inhabitant of the Southern States, and a second of California, while the third and fourth are common in all parts of North America, between the 30th and 60th parallels. Since their poisonous, and probably their therapeutic, effects are similar, I will first give a short description of each species, and devote the remainder of my remarks to the physiological and therapeutic actions of rhus toxicodendron, the common form of poison ivy in Canada.

Rhus pumilum, growing only in the Southern States, and very common in North Carolina, is a pubescent shrub, about a foot high, said to be the most poisonous of the Eastern varieties. Its pinnate leaves, consisting of about eleven oblong, coarsely-toothed leaflets, are downy beneath. The three upper leaflets are often confluent, the terminal one, when distinct, being attenuate at the base. The flower panicles are nearly sessile, while the drupes are covered with a red, silky pubescence.

Rhus diversiloba of Torrey and Gray, or rhus Jobata of Hooker, approaches very nearly to rhus toxicodendron. It is generally a shrub, but sometimes a climber, and is said to be the most poisonous of all the rhuses. It is chiefly a native of California, where it is known by the Spanish name of "hiedra." Its leaves consist of three, rarely five, obtuse, lobed leaflets; its flower panicles are shorter than the petioles; and its fruit is white and pubescent. With her usual generosity, Nature, according to Dr. Canfield, provides an antidote to poisoning by this species, in the shape of another Californian plant, the grindelia hirsutula, of which either the bruised plant itself, or a decoction, is applied to the parts.

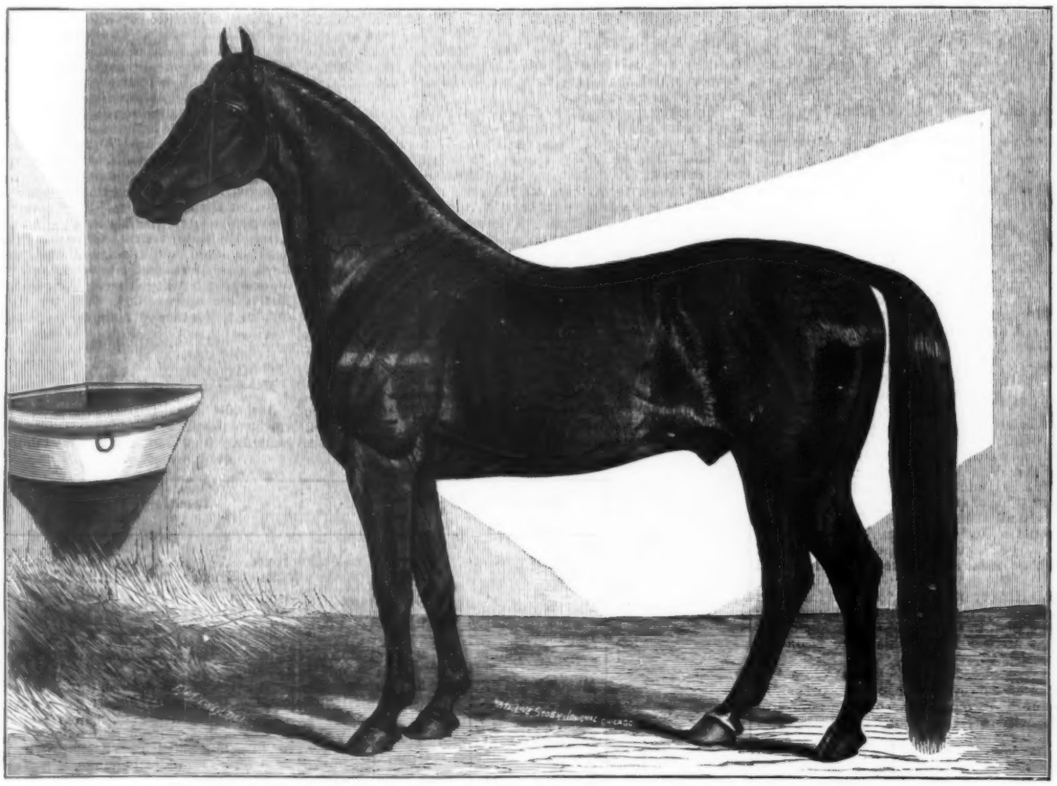
Rhus venenata, formerly called *Rhus vernix*, is known by the different names of poison dogwood, poison elder, poison ash, poison sumac, swamp sumac, white sumac, and varnish tree. Affecting rich, swampy ground in shaded situations, it is a shrub or small tree, usually growing from six to eighteen feet high, and one of the largest of our native species of rhus. The trunk seldom exceeds three inches in diameter, and, branching at a height of three to five feet, usually makes a repeatedly two-forked ramification, the final twigs terminating in thick clusters of leaves. The smooth bark is dark gray on the trunk, lighter on the branches, and reddish on the twigs and petioles. The leaves, expanding in May, are at first dark yellow in color, but become deep green with a paler under surface when mature, and finally, at the first touch of frost, assume a beautiful deep crimson hue, that can fairly vie with the maple for brilliancy of effect. The seven to thirteen leaflets forming the compound leaves are obovate oblong in shape, and entire. The small yellowish flowers are arranged in loose and slender axillary panicles, forming large masses of fragrant bloom, at the ends of the branches, which attract innumerable swarms of bees. Whether the honey derived from this source possesses any poisonous properties I am unable to say, but, as at various times there have been reports of poisoning by honey in particular localities, it would be a point well worthy of investigation whether this form of poison ivy does not also abound there. The berries, ripe in October, are whitish or dun-colored, with striate stones, and look somewhat like bunches of small grapes—a similarity, however, which is immediately dissipated by the slightest glance at the leaves, in the grape *simple*, in the rhus *compound*. Taken altogether, this tree makes one of the handsomest shrubs imaginable when in blossom, but is, unfortunately, one of the most deadly. Rhus venenata has been thought to be identical with the rhus vernicifera of Japan, and when incisions are made into its bark there is a copious flow of viscid fluid, yellowish at first, but soon changing to a deep black, which, when boiled, makes a fine varnish. The poisonous properties of this tree are said to be more powerful than those of rhus toxicodendron; persons exposed to its influence being more apt to suffer, and more severely. I have known several cases of poisoning due to this plant being mistaken for the common elder, an error which could never arise were the fact borne in mind that both varieties of elder, found in this country, have the margins of the leaves toothed, whereas in rhus venenata they are entire. In addition, the elders have dense masses of flowers, and a fruit which, when ripe, is either red or black, while this form of poison ivy has slender, scattered bunches of flowers, and a fruit whitish in color when mature.

Rhus toxicodendron may be made to include rhus radicans, as botanists are now pretty well agreed that it is merely a variety of the former; its differing form and characters, viz., more entire leaflets and high climbing stem, being dependent on the circumstances of its *habitat*. Rhus toxicodendron was first described in 1635 by Cornutus, in his works on Canadian plants, as a species of ivy. The Indians were well aware of its properties, and its effects were mentioned by Kalm and other travelers in North America. Poison oak, poison ivy, poison vine, poison creeper, and sometimes poison mercury, are names applied to it. It is found within the same range of territory as the rhus venenata, and is by far the commonest form throughout Canada. It generally grows in fertile and low grounds, but will thrive in barren and elevated places, and attaches itself to any bodies in its vicinity by numerous thread-like rootlets given off from the stem. Sometimes it climbs spirally to the tops of our tallest trees, attaining a height of forty or fifty feet; again, it is met with along the sides of fences, which serve as a convenient support, or crawling over bush, or rocks, or along the ground, in which cases it never exceeds from one to three feet in height. This low form sends off many small branches, the pendulous extremities of which often give the plant a bushy appearance. The stems are from one-quarter to two inches in thickness, and covered with a grayish-brown bark. The leaves, which are said to be eaten by cattle with impunity, are trifoliate; the leaflets being rhombic ovate, pointed, pubescent beneath, and variously notched, of a shining red when they first appear in the spring, but bright green at maturity. The flowers are small, greenish-white in color, and disposed in simple axillary racemes. The fruit is a round dry berry, as large as a pea, of a pale green color, ripe in October. Like rhus venenata, from the bark, when wounded, exudes an acrid, milky juice, which, exposed to the air for a few hours, changes to an intense black, which will leave indelible stains on linen or cotton, not effaceable by any known chemical, and which has been used as a marking ink. According to Dr. Jos. Khittel, the principal chemical constituents of poison ivy are gallo-tannic acid and a volatile alkaloid, to which it owes its poisonous and medical properties. The later researches of Prof. Maisch, however, have proved that the acridity of the juice is due to the presence of a hitherto unknown volatile acid, analogous to, but distinct from, formic and acetic—toxicodendric acid, which, when isolated, is found to affect the skin, either by direct contact or by its vapor, exactly as the fresh plant itself does, proving beyond doubt that the poisonous properties of the plant are due to it. This principle is in great measure dissipated in the process of drying, and hence dried preparations of the plant are much less apt to act noxiously, though even these should be handled with great care by such as are susceptible to poisoning by it. The plants for which rhus toxicodendron is most often mistaken are the Virginian creeper or American ivy (*Ampelopsis quinquefolia*), with which the climbing variety often entwines itself, and the *Aralias*, *Nudicaulis*, and *Quinquefolia*, commonly known as wild sarsaparilla and ginseng, often found growing with the low form. The plants are very easily distinguished if one will take the trouble to remember a single simple distinctive mark, viz., five leaflets on a single leaf-stock, whereas rhus toxicodendron has only three. Other distinguishing marks are, that the aralias have regular serrate leaves, and in nudicaulis the flower stem is separate from the leaf-bearing one.

DON COSSACK.

NEAR Joliet, Ill., is the extensive stock farm of Judge J. D. Caton, the well-known writer and agriculturist. Among the splendid animals with which his domain is stocked is the subject of our sketch, the four-year-old stallion, Don Cossack, probably as fine a specimen of good breeding as exists anywhere. Don Cossack is a handsome mahogany bay, with small white spots on inside hind ankles; foaled April 8, 1876; 16½ hands high, and weighs 1,200 lb.; bred at Glenview Stud Farm, Jefferson Co., Ky., by J. C. McFerran & Son; got by August Belmont, son of Rysdyk's Hambletonian; first dam Laytham Lass by Alexander's Abdallah; second dam by Mambrino Chief; third dam sent from Ohio to Kentucky, to be bred to Mambrino Chief, and said to be by Bellfounder.

Don Cossack, as a two-year-old, trotted a full mile in 2:45. As a three-year-old, he trotted a quarter in 37 seconds and a full mile in 2:39. He won the three-year-old race at the Fair at Louisville, in September, 1879, winning the third heat in 2:42, trotting the last half of this mile in 1:17, at the time



DON COSSACK.—PREMIUM FOUR YEAR OLD STALLION.

weighing 1,175 lb., thus proving himself to be a colt of rare individual merit. As a four-year-old Don Cossack was kept in the stud, but was exhibited at the Illinois State Fair, held at Springfield, and was awarded first premium as the best stallion, four years old and over, defeating a field of thirteen stallions; he was also awarded first premium as the best driving stallion of any age, speed considered. In his breeding he unites the two great and popular trotting families, the Hambletonians and the Mambrinos.

SCIENTIFIC BREEDING.

By J. D. CATON.

THE scientific breeding of domesticated animals involves, first, a knowledge of the principles of biology and generation, which may be learned by careful observation and experiment; then the art of applying these laws, so that, by training or discipline, we may create characteristics which, in obedience of these laws, we have ascertained may become hereditary. Then, by cultivating these desirable characteristics and breeding from those individuals in which they appear to be the most highly developed, an improvement may be hoped for in each succeeding generation. In the same way undesirable characteristics may be eliminated. This may be called scientific breeding, which, so far as our domesticated animals are concerned, is perfectly under the control of man. Could the same laws be applied to man with the same rigor, the improvement in the race would, no doubt, be more pronounced than it is possible to make it in the brute creation. When circumstances compel the cultivation of certain characteristics, whether physical or mental, in a race of men, we may be surprised to see how rapidly they grow and how soon they become hereditary.

But it is only where these laws have been studied, and are arbitrarily applied by the intelligence of man, that we see the

most astonishing results. A separate chapter, and a long and an interesting one, might be written upon the improvements thus wrought in each of the species of our domesticated animals, but I will only allude to the immediate subject which has suggested these reflections—the horse, or, to be more particular, the American trotting horse, more properly termed the roadster. He is the growth of but a very few years—a growth so rapid that its progress can be noted year by year. The great object is to produce a superior carriage horse, or, in the plainest terms, a roadster. For this purpose certain characteristics are required, to the attainment of which the judicious breeder is always aiming. Large size is required to give the necessary strength to perform effective service under all circumstances; but this size must be so distributed as to produce the most desirable form. He must have great endurance and courage; he must have high spirits, and yet be gentle and tractable; he must be beautiful in color, form, and action—indeed, an elastic, graceful motion, with the necessarily accompanying expression of the eye, is one of the most charming features of a beautiful horse. He must have speed as a trotter, for that is the only gait appropriate for a carriage horse. Many other desirable points might be mentioned—points which should be cultivated to make the perfect carriage horse; but they must be omitted here.

Form and size could have been cultivated in a reasonable time from almost any stock, but not great endurance, high spirits, gentle disposition, elastic action, and great speed. These had to be imported, not into America only, but into Europe as well. The Arabian horse was brought to several countries of Europe by the returning Crusaders, if he had not already been introduced there, and was there developed in the course of time into the enormous, though active and spirited, Percheron Norman horse of France, the hunter of England, and the running horse everywhere. But breeders were not entirely dependent upon the Arabian stock first introduced. Fresh importations were frequently made, which, by judicious breeding, developed the modern race-horse or thoroughbred. There are no thoroughbred trotters; but all the fast trotters are descended from thoroughbred sires, from which they got their speed, activity, and endurance, and, I may add, kindly disposition. All the great trotting stock of America has descended from a few celebrated sires, but few removes from thoroughbreds, and which themselves never developed great speed. Indeed, it is hardly practicable to subject breeding stock to the severe and long-continued training indispensable to the development of the greatest speed. Were such development practicable in breeding stock it would, no doubt, be very desirable from hereditary considerations; but it seems to be impracticable, except to a limited extent. The dam cannot be trained while breeding, nor the sire to a degree sufficient to attain the greatest development. It is perhaps unfortunate that the fastest trotters are not kept for breeding. Their owners think they can make them more profitable on the track; or, if their circumstances are such that they are indifferent to the pecuniary consideration, the same result is produced by ambition or pride to own the fastest trotter in the world. If the development of great speed acquired by long and judicious training is a habit or characteristic likely to become hereditary, then the progeny of Maud S., for instance, were she put to breeding now, might be expected to inherit the same characteristic in a higher degree than would have been possible if she had never been trained, and the characteristic might be expected to be more strongly inherited in the second generation, according to the observations of many judicious breeders. But most breeders of roadsters do exercise their colts, more or less, before they are put into the stud or the fold, and many of them to a very considerable extent. The more promising the colt the more it is likely to be exercised to develop speed, and thus the capacity for speed is artificially developed and augmented, and so transmitted to their progeny.

Nothing in the development of an extraordinary capacity in the past can be compared with the rapid progress which has been made within a very few years in increasing the speed of the trotting horse. This colt Don Cossack is the grandson of Rysdyk's Hambletonian, the founder of one of the three great trotting families of this country, and already his descendants are the greatest trotters the world has ever seen. The wonder is that this manifest improvement is not the work of centuries or of decades, but of years. Each year shortens the time appreciably, and that, too, after the shortest time previously supposed to be attainable has been reached; and this improvement is now going on more rapidly than ever. Judging from the past, we may safely assume that the colt is already foaled that will far outstrip any of the present celebrities. And he would be a rash man who would venture to set a limit to the speed of the American trotter.

But it may be asked, What good can result from this high speed? What better is the horse that can save one or two seconds of time in the mile? For practical or business purposes there is no benefit, for no one riding after them can appreciate the difference. The practical benefit is in the efforts, inspired by this competition to attain high speed, which results in the improvement in the action of the whole race of roadsters. If there is an annual improvement of a few seconds in the fastest, there may be expected an equal or greater improvement in all grades below them in speed, and so there is a general improvement in the action of the great multitude designed for practical use as carriage horses. The great improvement which has taken place in this class of stock may be observed any day on our streets, where the most elegant and beautiful horses, in form and action, to be found in the world, are constantly met with. Nowhere else has this class of horses been so much studied or so great efforts made by scientific breeding and handling to elevate them to the highest standard.

The race-horse, at full speed, under the saddle, is, indeed, a beautiful object, while he would present a revolting spectacle before a carriage. According to the universal tastes of cultured men, the trotting gait is the only one of grace and beauty before a carriage; and it is unaccountable that it has never been scientifically cultivated till within the last few years, and in our own country. The race horse, the draught horse, and the saddle horse have all been cultivated and vastly improved by judicious breeding during hundreds of years, and especially in later times, while the roadster has been neglected till now. Much of this may be due to the æsthetics of later times; for there has no doubt been a great improvement in the public taste in this regard, and its demands are rapidly increasing for beauty of form and graceful action in our carriage horses.

PEACHES.—The peach has, for the past few years, made better returns for good and careful cultivation and labor expended, than any other fruit for market. There is no crop that can be raised with less labor and expense, and a quicker return, than that of the peach, and none that will give a greater return for the capital and labor employed. If this should meet the eye of some one who is tired out with farming, let him plant ten acres of peach trees, and see in four years what the result will be.

A BUFFALO RACE IN THE PHILIPPINE ISLANDS.

THE buffalo of India, called in the Philippine Islands *carabao*, when domesticated renders great service as a beast of burden and for plowing, but has not hitherto attracted the attention of jockey clubs as being fitted for the race course.

The usual gait of this strong heavy animal is very deliberate, and suggestive of anything but racing; but when on a gallop he presents quite a different appearance, and experienced hunters have sometimes found great difficulty in escaping from the charge of a buffalo when angered.

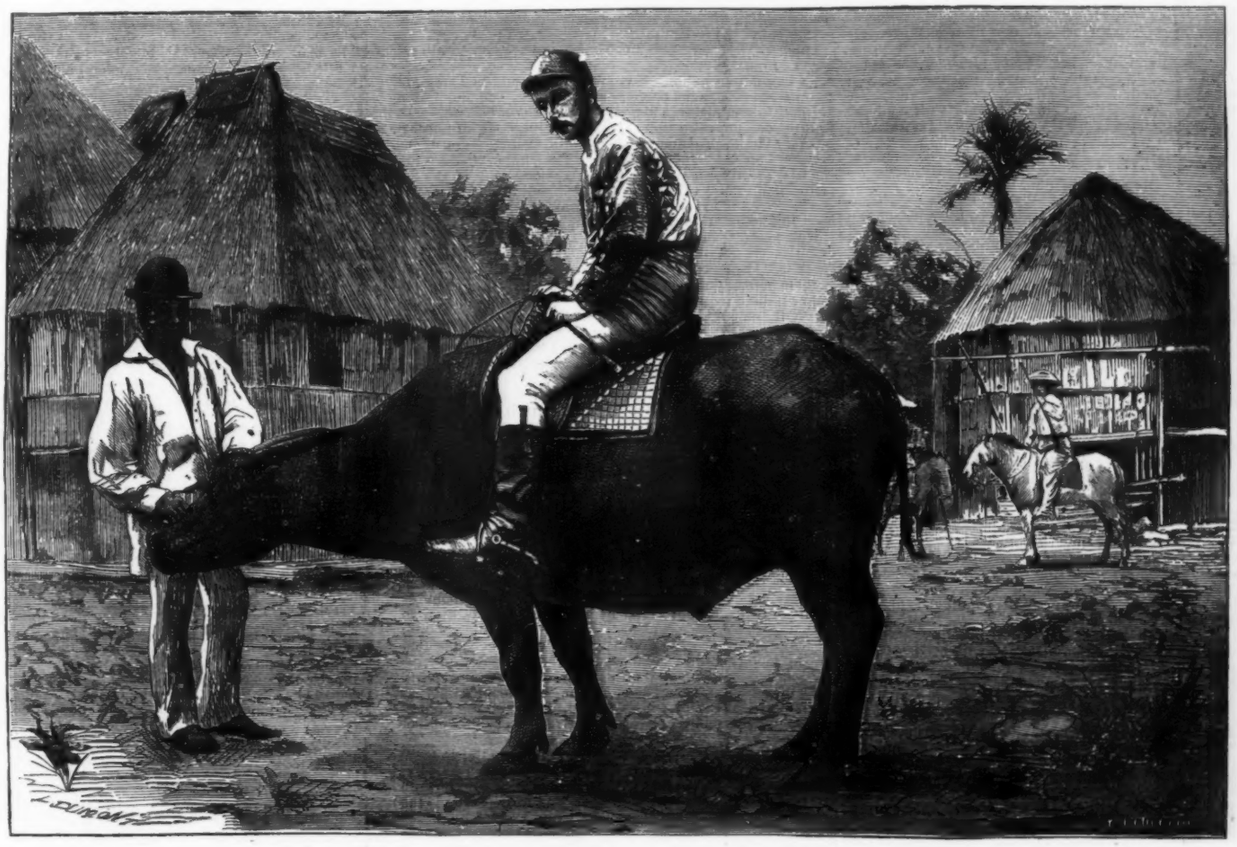
This peculiarity suggested one day to some young men of Manila the idea of organizing for their amusement a race of these *carabaos*, on the neighboring plains of Mariquina, and they procured six superb animals for this purpose.

The start was extremely difficult. These novel coursers were not accustomed to European riders, and the race presented many ludicrous features.

These buffaloes have a particular predilection for large quagmires filled with mud, and will wallow together there for hours to protect themselves from the sun and flies. One of these coursers took the direction of a quagmire or "carabao-hole," as they are commonly called, in order to rid himself of his rider by plunging into it up to his neck. Another jockey was thrown into a rice field head first.

Three of the buffaloes, however, behaved admirably and ran well, and the first prize was only gained by a horn's length, to the great amusement of all the country people who had assembled to witness this novel spectacle.

The *fête* terminated gayly with an excellent collation, served under a beautiful mango-tree, and enlivened by the music of an orchestra composed of small boys playing on flutes and rude instruments made of bamboo, and a number of young girls improvised a song in honor of the winners of the race.



THE CARABAO, OR BUFFALO OF THE PHILIPPINE ISLANDS.

DEEP SEA LIFE.

ALL the recent exploring expeditions have established the fact that animal life of various kinds abounds everywhere in the deepest parts of the ocean. Nor is such life microscopic or minute only. In the Challenger voyage was procured by the trawl, at the depth of 1,600 fathoms, in [illegible] South Atlantic (S. lat. 46° 16', E. long. 48° 27'), a living specimen of a magnificent shell belonging to Cymbium, or an allied genus, which is 6¾ inches long and 4 inches broad! I dredged other mollusca from an inch and a half to nearly double that length in the Porcupine and Valorous expeditions. Willemöes Suhm mentions among the Challenger discoveries a gigantic crustacean or sea-spider, from 1,375 fathoms, which measured nearly two feet across the legs.

Sir Wyville Thomson gives an eloquent description of life in the deep sea, when he says that the latter "is inhabited by a fauna more rich and varied on account of the enormous extent of the area, and with the organisms in many cases apparently even more elaborately and delicately formed, and more exquisitely beautiful in their soft shades of coloring, and in the rainbow tints of their wonderful phosphorescence, than the fauna of the well-known belt of shallow water teeming with innumerable invertebrate forms which fringes the land. And the forms of these hitherto unknown living beings, and their mode of life, and their relations to other organisms, whether living or extinct, and the phenomena and laws of their geographical distribution, must be worked out."

It was formerly supposed that animals could not exist at great depths because of the great pressure to which they were

subjected. Mr. Moseley says* "the pressure exerted by the water at great depths is enormous, and almost beyond comprehension. It amounts roughly to a ton weight on the square inch for every 1,000 fathoms of depth; so that, at the depth of 2,500 fathoms, there is a pressure of two tons and a half per square inch of surface, which may be contrasted with the fifteen pounds per square inch pressure to which we are accustomed at the level of the sea." But it must be recollected that water is nearly incompressible, and that marine animals which are surrounded by such a fluid, and are to a certain extent filled with it, would not necessarily be inconvenienced by the superincumbent weight.

Animals from great or even from what may be considered moderate depths are always brought up dead, the cause of death being unknown. This is another problem worthy of being worked out.

The migration or distribution of marine animals throughout the open sea is quite free, and is unobstructed only by great or abrupt changes of level in the bed of the ocean, which operate as barriers. Even animals of a fixed or sedentary nature in their earliest state of growth swim on the surface, and are therefore unchecked in their onward course by any submarine barrier.

The doubt whether any life exists in the intermediate space or zone which lies between that of the surface and that of the bottom of the deep sea has now, I believe, been set at rest. The naturalists in the Josephine expedition believed that this intermediate zone is lifeless; and Sir Wyville Thomson seems to be of the same opinion. The towing-net adopted by Mr. Murray in the Challenger expedition for such researches was to some extent successful; but Capt. Sigsbee, of the U. S. Coast-Survey steamer Blake, invented a cylinder or machine, called the "gravitating trap," which completely answered the purpose of collecting at any particular depth the animals which occurred there. Prof. Alexander Agassiz, in his communication to the superintendent of the survey, made last August and now published, records the experiments thus made, and says that they "appear to prove conclusively that the surface-fauna of the sea is really limited to a comparatively narrow belt in depth, and there is no intermediate belt, so to speak, of animal life between those living on the bottom, or close to it, and the surface pelagic fauna."

J. GWYN JEFFRIES.

* "Notes of a Naturalist on the Challenger."

ANIMAL LIFE.

By J. H. BARKER, M.D.

No one can doubt that in all its main features our corporeal life is identical with that of the lower animals, and that it is subject essentially to the same conditions. And as in their case, so in that of the human organism, I conceive it is absolutely necessary to maintain the distinction between the vitality of the *bioplast*, whether connected with the more solid tissues, or floating in the fluids of the body, and the *life* of the *whole organism*. It is to this latter state that we refer when we speak of "life and death" as regards any individual human being. The necessity of this distinction will be apparent when we consider the experiments which have been made with such success in transfusing a part of the living blood of one man into the veins of another, who, by disease or loss of blood, was in danger of dying. No one can imagine that the blood corpuscles thus introduced into the failing body of the one person transported any part of the "anima" of the other into his body. If we regard, as we must do, the living being, or "anima," as one and indiscerptible, the idea of such a transfer, which leaves the person who parts with his blood in full possession of life and soul, is entirely inadmissible. It follows, therefore, that, whatever connection may exist between the two kinds of life, they cannot be properly called identical. The same inference is to be drawn from the fact before alluded to in regard to animals, that the cessation of vitality in the organs of the body (*e. g.*, the contractility of the muscular fiber) is not coincident with the departure of the aggregate life of the system. On the other hand, the corpuscular life may cease, at least partially, in almost any part of the body, while the union of the soul continues intact.

It is as impossible to say what amount of corpuscular vitality is adequate to maintain this union between soul and body as it is to describe the nature of that union. It may differ, not only in every animal species, but in every individual, and with every period of life. But the fact of some mutual dependence is obvious. The former state is probably of the same nature as that which we see manifested in vegetation, and which predominates in the "Protista," the direct acting cause of which is, according to the present theory, the Supreme Will of the Deity.

But the *life* or living state of the whole human body is the union of the "anima" with the corporeal organism. I suppose this "anima," though of the same *order* of being as those of the brutes, yet to constitute a distinct *class*, endowed with far higher prerogatives and capacities, and destined by its Maker, not for a transient, but for an eternal, existence. Into this subject, however, I do not propose further to enter at present. My next step is to inquire whether there appears to exist any material link between body and soul, which is essential to the living state, and which is common to man and other animals.

It is the general belief of physiologists that in the animal nervous system there exists a fluid, or influence, of a nature closely allied to voltaic electricity, as evidenced by a number of well-known experiments. The human brain is, therefore, often spoken of as a *living voltaic battery*, and the nerves are compared to the metallic electrodes. It is certain, moreover, that a continuous supply of this nerve influence is essential both to sensation and to voluntary, indeed, to *all* muscular action. The living being holds converse with external objects, and especially with its fellow-creatures, by means of its five senses, at the special seats of which it must be regarded as locally present, to receive and interpret the meaning of the impressions conveyed from outward objects. Now with respect to two of our senses at least, we know that the impression is made by vibratory and undulatory motions in circumambient media, causing corresponding motions in the nerves; those in the ether being transferred to the optic, and those in the air, liquids, and solids to the auditory nerves. It may be asked, then, with reference to vision, whether the motion which was unquestionably in the ether, suffused through the air in external contact with the cornea of the eye, actually penetrates the clear structures of that organ? According to the corpuscular theory of light, it would be so; but the wave theory only admits the propagation of *motion in ether*. Then the ether must also permeate the ball of the eye, and the ray of light *in* the eye consist of undulations in that interfused ether. May we not, then, reasonably suppose that this ether meets at the retina with a medium of its own nature, permeating and acting upon the expanded nerve-tissue and taking up its vibrations? The nerve-fluid, however, is not the percipient being; it is but its servant, however indispensable, even as the nervous system and the body, as a whole, are. And this seems to indicate such a special connection with the *mind* or *soul*, *i. e.*, the living "*ego*," that it may be properly termed the *link* between soul and body.

The fact that this ethereal nerve-fluid is also essential to muscular contractility, and so to voluntary motion, offers additional evidence of the truth of this view of the matter. Moreover, the necessity for the presence of some degree at least of heat (another form of ether-motion) to vital functions, and, indeed, to the continuance of life itself, seems to prove the presence of some form of ether in the nervous system, as well as in every other part of the living body. In applying the term ethereal to the nerve-fluid I do not mean that it is absolutely identical with the free ether of space. But may it not well be that the ether, which, undoubtedly, exists all around us, may be modified in its qualities by being taken into combination with that wonderful organic product, the nervous tissue? May it not be one of the functions of the brain and of other ganglionic centers to draw from the air, through the aeration of the blood, constant supplies of this vital element?

The blood is, no doubt, the *life* of the corporeal system, and that in more senses than one. And it is so in a specially important sense, if one of its chief functions is to *distill*, as it were, from the air we breathe, and store up in the brain, that empyreal form of matter whose activities are requisite to enable the nerves, both of sensation and volition, to fulfill their varied functions. And in connection with this subject, is it not possible, nay probable, that many of the perplexing but indisputable facts of *mesmerism* may find a solution, in the action of a strong will upon the nerve-fluid, and by the medium of the ether, combined with the air, acting upon the nervous and muscular system of the person subjected to it?

Human "life," then, in the higher sense, is the continued union of soul and body by its ethereal link, and death is the cessation of that union. So far the man and the brute are alike, and perhaps the correlation may be extended one step further, to include the phenomena of *dormant* life, although in some obscure cases it may be wholly impossible to decide whether vitality has finally ceased until disintegration of the organism has taken place; but here the similarity ends. In the case of all animals except man the cessation of the life is the end of the existence of their "anima." The beasts *perish*—cease to exist. The purposes of their creation have been fulfilled, and they are no more.

Not so, however, in respect to man. To him physical death is that of the body only. As regards *his* "anima," death is its separation from the gross corporeity, which had been in a state of ceaseless flux from the first, and its entrance upon a fresh stage of existence. Into this new condition it may, and I believe will, enter with the full consciousness of its own existence; and associated with that ethereal substance which in this world were constituted the mysterious link between it and the body, and will thenceforward be the vehicle of the soul in its new condition. And thus will, we may suppose, be maintained the continuity of material conscious existence. For I regard it in the light of a physical necessity that a created mind should have some species of embodiment *during its whole existence*. The limitation of mind by material corporeity seems to be the only possible mode of giving it either individuality or locality. Not that such a state of non-corporeity is an abstract impossibility, but that it seems inconsistent with all we know of the nature and relations of the two entities. The beings we ordinarily speak of as *spirits*, whether they have once dwelt in earthly bodies or not, have probably as real a corporeity as we have, although ethereal in its nature, and, therefore, ordinarily invisible to us. We must, however, remember that ether itself, the very *matter of light*, is absolutely invisible to us, except it be in a certain definite kind of motion.

I may further observe that it is quite as conceivable that a living being should be embodied in the ethereal as in the more concrete and solid forms of matter. Such a transformation, then, may be in store for the human family, as the late Isaac Taylor shows to be probable on the highest philosophical grounds (see his "Physical Theory of Another Life," *passim*).

According to our present theory, therefore, matter in some form or other is the actual *basis* of life, and that, probably, everywhere in the physical universe. And the only cause and reason of this is, that it seemed good to Him who is the first and last cause of all existences, natural or spiritual.

Of the essence of matter we are, in our present state, profoundly ignorant; we only know some of its effects or properties. But whether it consists of the corpuscles of a Newton, or the fire-mist of a Laplace, the atoms of a Dalton, or the infinite centers of force contended for by a Berkeley or a Boscovich, one thing is certain—that there is behind and beyond, beneath and above, yea, *in* all matter, visible or invisible, known or unknown, a supreme intelligent Being, "the Father of lights," the Maker, Upholder, and Ruler of all, and the ever-living Source of all life.

To sum up briefly the whole subject, I regard terrestrial "life," whether animal or vegetable, not as a distinct *entity*, but *as a temporary condition of certain peculiar kinds of matter*, the efficient cause of which condition is the will of the Supreme, incessantly working as an Omnipresent Being in forming and maintaining living things, chiefly by means of ethereal forms of matter, which are put into various modes and degrees of motion by the same Power; that some of these activities in the ether are identical with what are known as "the physical and cosmical *forces*" of nature, which, as respects their *origin*, are not to be distinguished from the vital activities in the molecules of living things; that this kind of life is simply the continuance of that action in organized matter, and the death of such molecules is the cessation at any point of that action. But in the animal kingdom there is an additional created entity (here designated the "anima") situated in two terrestrial classes, and united to the corporeal organism, as a whole, by a special form of ether in the nerves; that this union, while it subsists, constitutes animal life, in the usual sense of the term, and that the termination of that union is the death of the whole organism; that the two classes of "anima" are distinguished from each other by various qualities and capacities, but chiefly by the fact that the lower class is formed only for a transient existence, which ends with their bodily life, while the human soul is destined for an eternal duration in a future state; and that its natural death is only the separation of the psychical and ethereal parts from the corruptible materials which constituted the soul's embodiment in the first stage of its existence.

I may add, in conclusion, that, even if the foregoing theory be discarded and "life" be regarded as a separate entity, we should still be compelled, with the authors of "The Unseen Universe," to recognize the existence and omnipresence of a great "Lord and Giver of Life"—the Third Person of the Christian Trinity.—*Journal of Science.*

EXPORT OF AMERICAN HOGS.

AN imperial decree of Germany having prohibited the importation into that country of American sausage and minced hog meat, United States dealers at once began the exportation of live pigs, against which, like certain moral attributes mentioned by St. Paul, there is no law. The sturdy German hog-lovers received this contribution from America in a very friendly spirit, found the consignments wonderfully cheap, and took to them very kindly, distributing the live pigs among the butchers inland, the latter gladly receiving them. The largest loss upon any one shipment has been forty out of a cargo of nine hundred, and the average loss on the voyage on all the shipments has been only 2½ per cent. So, now, Western stock dealers are preparing to go into the business largely. The objection on the part of the German government to the "dead hog meat" was that it was liable to adulteration, and "mighty uncertain," so to speak. The live article will speak, or rather grunt, for itself.

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